DOCUMENT RESUME

ED 390 946 UD 030 681

AUTHOR Atwater, Mary M., Ed.; And Others
TITLE Multicultural Education. Inclusion of All.
INSTITUTION Georgia Univ., Athens. Dept. of Science Education.
SPONS AGENCY Eisenhower Program for Mathematics and Science Education, Washington, DC.
REPORT NO ISBN-0-9624818-2-3
PUB DATE 94
CONTRACT S1641310010
NOTE 297p.
AVAILABLE FROM University of Georgia Press, 330 Research Drive, Athens, GA 30602-4901.
PUB TYPE Books (010) -- Collected Works - General (020)

EDRS PRICE MF01/PC12 Plus Postage.
DESCRIPTORS *Access to Education; *Cultural Awareness; Educational Assessment; Elementary Secondary Education; *Equal Education; Family Characteristics; Limited English Speaking; *Mathematics Instruction; Minority Groups; *Multicultural Education; Racial Discrimination; *Science Education; Sex Discrimination; Teacher Education; Teaching Methods

ABSTRACT

Chapters in this book reflect the issues in multicultural education that affect the teaching and learning of mathematics and science. They are grouped into sections on teacher education, learning and instruction, assessment, and family and society and include: (1) "Multicultural Teacher Education Programs in America: A Friendly Confrontation" (James Boyer and Kelly A. Radzik-Marsh); (2) "Equity and the Teaching of Mathematics" (Walter Secada); (3) "Moving Towards Culture-Inclusive Mathematics Education" (Patricia Wilson and Julio Mosquera Padron); (4) "A Comprehensive Multicultural Teacher Education Program: An Idea Whose Time Has Come" (H. Prentice Baptiste); (5) "Examining Teaching Styles and Student Learning Styles in Science and Math Classrooms" (James Anderson); (6) "A Comparative Study between Italian and Korean Students' Methods for Solving Word Problems" (Woo Hyung Whang); (7) "Interrelationships between Gender, Affect, and Retention in Science Classrooms: A Theoretical Approach" (Jane Butler Kahle); (8) "Effective Programming for Limited English Proficient Students" (Sheryl Santos); (9) "Criticalmathematics Education: Bringing Multiculturalism to the Mathematics Classroom" (Marilyn Frankenstein); (10) "The Teacher Shortage and Testing: Simple Ignorance or Racism?" (G. Pritchy Smith); (11) "The Impact of Standardized Testing on Children of Color" (Gina Dyer); (12) "Mathematical Empowerment and African American Families" (Marilyn Strutchens); (13) "The Conflict between Teacher and African American Family Questioning Patterns" (Catherine Gardner, Evelyn Hart, and Bobby Jones); and (14) "Paths to Multiculturalism: One Perspective" (Randy McGinnis). References follow each chapter. (Contains 6 figures and 10 tables.) (SLD)

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Multicultural Education

Inclusion of All

Edited by Mary M. Atwater, Kelly Radzik-Marsh, and Marilyn Strutchens

UD 030 681

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Multicultural Education

Contributing Authors

James Anderson
Carol Archer
Mary M. Atwater
H. Prentice Baptiste
James Boyer
Gina Dyer
Marilyn Frankenstein
Catherine Gardner
Evelyn Hart
Bobby Jones
Jane Butler Kahle
J. Randy McGinnis
Julio Mosquera Padron
Kelly A. Radzik-Marsh
Sheryl Santos
Walter Secada
G. Pritchy Smith
Marilyn Strutchens
Woo Hyung Whang
Patricia Wilson

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Mary M. Atwater
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Marilyn Strutchens

This work reported herein is the result of a project from the Department of Science Education of The University of Georgia. It was supported under the Eisenhower Act for the Improvement of Mathematics and Science Education under the Higher Education Section of P.L. 100-297 Title II (PR/Award S1641310010) as administered by the U.S. Department of Education. The findings and opinions expressed here do not necessarily reflect the position or policies of the U.S. Department of Education.

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FIRST PRINTING
Printed in the United States of America

ISBN 0-9624818-2-3

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Mary M. Atwater
The University of Georgia
Department of Science Education
212 Aderhold Hall
Athens, Georgia 30602-7126

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PREFACE

The purpose of this book, *Multicultural Education: Inclusion of All*, is to provide an opportunity for science and mathematics educators, along with researchers, to become cognizant of the myriad of issues in multicultural education that affect the learning and teaching of science and mathematics. Since testing has become a major issue in science and mathematics education, a chapter on its multicultural implications has been included. The chapters in this book have been written by researchers, teachers, and former University of Georgia graduate students. Many of them started on their paths in multicultural education many years ago; others have just begun. We urge the readers to read the chapters and reflect on their own experiences in multicultural education, for it is one field of inquiry that has as a goal the inclusion of all. In this book, we do not look for one voice in the field of multicultural education because many voices must be heard if the field is to continue to be inclusive.

Finally, we request that all the readers of this book, teachers, students, and researchers share with us their own multicultural experiences in science and mathematics education so that we might integrate it with our own and with others' scholarship in this expanding discipline called *multicultural education*.

ACKNOWLEDGEMENTS

We are indebted to the authors for writing their chapters and revising them in response to our comments and suggestions. We owe our gratitude to Ms. Valerie Kilpatrick who typed several of the chapters and retyped others and provided the organizational skills necessary to keep us on task. We would like to thank Ms. Virginia Calder for her helpful suggestions related to the design and publication style of the book and also Ray Lee, Nathalie Senné, and Pasha Souvorin for assisting her with the typesetting and graphics. In addition, we thank Dr. Judith Chandler for her editorial wisdom and sage advice. If it had not been for the encouragement of Dr. Russ Yeany, it would have been very difficult to continue this publication effort. The assistance of Ms. Christine Blanke of Thomson-Shore, Inc., in the printing and publishing of this book is greatly appreciated. The College of Education at The University of Georgia is the publisher of this book and the Center for Educational Technology in the College of Education served as the compositor. Finally, it was through the financial assistance from an Eisenhower grant through the United States Department of Education that this book was published. This grant enabled both mathematics and science teachers in Georgia to receive this book free of cost and other faculty members and precollege teachers to purchase this book at cost. However, the opinions expressed by the authors of the various chapters in this book do not necessarily reflect the views of the United States Department of Education, and no official endorsement by the United States of Department of Education should be assumed.

M. M. A.
K. R. M.
M. S.

INTRODUCTION

Invitations of the Past and Inclusions of the Future in Science and Mathematics

Mary M. Atwater

Teachers, teacher educators, and policy makers can no longer ignore the issues of ethnicity, culture, gender, and class in science and mathematics classrooms. They must directly address the issues raised in this book. Important facets of learning and teaching for African American, Asian American, Hispanic, Latino, Native American, and White female students can no longer be ignored because of the rapid diversification of American classrooms. The philosophy of the authors is that stakeholders must be committed to creating environments in which all students can be successful in science and mathematics classrooms. Students are not the problem (a deficient-model philosophy) because all students bring knowledge and skills which can help them be successful in these classrooms. Teachers must build on their students' knowledge and skills so that all students can understand the scientific and mathematical principles, laws, and theories; can think critically; and can use their science and mathematics understanding in their decision making.

Multicultural education has not ever been clearly defined, but it is recognized as a field of disciplined inquiry devoted to research using quantitative and qualitative approaches and to the development of educational policies and practices so that all students can learn. The challenges in the domains of multicultural education as it relates to science and mathematics are varied; they include teacher education, learning and instruction, assessment and evaluation, and family and societal influences. The authors of this book have taken the position that all students must be included in equitable experiences in science and mathematics classrooms in order to promote meaningful learning for all. Correspondingly, they have directed themselves to provide a rationale for this inclusion and delineated and clarified the essential dimensions of the roles, responsibilities, and functions necessary to meet the challenge of including all in science and mathematics education. Many look at past efforts in science and mathematics education

and ways those efforts have failed to include all. Part 1 focuses on the multiculturalism in teacher education programs. **James Boyer** and **Kelly Radzik-Marsh** begin this part of the book with a discussion of the history and inadequacies of American teacher education programs. They argue that the transformation of American teacher education lies in the philosophy, knowledge base, and teaching practices of multicultural education. **Walter Secada** continues this discussion by focusing on equity and the teaching of mathematics. He recommends that we enlist the assistance of teachers in achieving equitable mathematics teaching of the diverse student populations found in the United States. **Patricia Wilson** and **Julio Mosquera Padron** discuss ways culture-inclusive mathematics moves us toward the inclusion of all in mathematics. Finally, **Prentice Baptiste** proposes a comprehensive multicultural teacher education program.

In Part 2, "Multiculturalism in Learning and Instruction," the focus is on enhancing the learning and teaching of science and mathematics. **James Anderson** examines teaching styles and student learning styles in science and mathematics classes. He maintains that the task of teachers is to begin to erect structures which accommodate the disparate ways students desire to learn. **Woo Hyung Whang** discusses a comparative research study between Italian and Korean students and identifies their implicit models for solving multiplication word problems. **Jane Butler Kahle** provides a theoretical basis for gender differences in interest levels and retention rates in science. In addition, she describes various intervention programs that enhance females' attitudes and interest in science. Some science and mathematics classrooms are filled with Limited English Proficient students; other classrooms have a few. **Sheryl L. Santos** proposes how schools can meet the academic, social, emotional, and psychological needs of their linguistically and culturally diverse students and their families as students prepare themselves to meet the science and mathematics challenges of future. Lastly, **Marilyn Frankenstein** discusses criticalmathematics education and its connection with multicultural education and provides examples of how to use mathematics to empower students.

Part 3 addresses the intersection of multiculturalism with assessment. **G. Pritchy Smith** examines the minority teacher shortage and

testing. He asks the question: Was standardized testing of preservice and inservice teachers in this country conducted out of simple ignorance or racism? **Gina Dyer** then provides a history and analysis of standardized testing and its effect upon students from underrepresented groups in science and mathematics.

Finally, family and society influence the inclusion of all in science and mathematics classrooms in the United States. Part 4 concentrates on these influences. **Marilyn Strutchens** calls for family involvement to empower African American students in mathematics classrooms. She describes intervention programs in which African American families have successfully been involved in classroom activities. **Catherine Gardner, Evelyn Hart,** and **Bobby Jones** propose that there might be a conflict between teacher and African American questioning patterns after conducting a pilot study on assessing the questioning patterns of students in elementary science classrooms. **J. Randy McGinnis** concludes this part with his own personal experiences that began his journey in multicultural education. These experiences have important implications for teacher education programs in this country.

Without a doubt, the authors in this book provide us with an in-depth discussion on important issues in multicultural education. Multicultural education efforts in the past have targeted the social sciences and to some degree mathematics. It is only a recent occurrence that discussions on ethnicity, culture, gender, and class have become a part of science education. Thus teacher preparation; the learning, instruction, and assessment of African American, Asian American, Hispanic, Latino, Native American, and White female students; testing of teachers of color; parental involvement; and societal beliefs and actions have become essential in science and mathematics so that all can be included in these two vital fields.

Part I:
Multiculturalism in Teacher Education Programs

1

Multicultural Teacher Education Programs in America: A Friendly Confrontation

James Boyer
Kelly A. Radzik-Marsh

The education of the American teacher is essentially the foundation of public literacy and the basis for the existing American mentality with regard to social justice, academic regeneration, and all human relationships. While few other institutions face this reality, those engaged in the education and development of the teacher must be aware of these major implications. American teacher education programs have failed to provide an agenda of social justice, academic justice, and intellectual congruency. While some of the major documents of this country declare these objectives of social and academic justice (like the Constitution, Bill of Rights, and the Declaration of Independence), the school curricula (including teacher education curricula) have failed to promote these objectives through learning and teaching.

For this cause, this chapter will attempt to identify the instances in which these objectives have been overlooked. Further, it will attempt to offer suggestions for multicultural development in programs which prepare teachers for America's children.

American Teacher Education: Its History and Inadequacy

In 1990, some 41 million children (Snyder & Hoffman 1992a) entered 84,538 elementary and secondary schools in more than 15,000 public school districts (Snyder & Hoffman 1992c). The principals of these schools were mainly White males; only 25% of these principals were female. Only 9% of them were African American, and 3% were Hispanic. Less than 2% of our public school principals were from other cultural groups: Asians, Pacific Islanders, Native Americans, and Eskimos (Snyder & Hoffman 1992b). Much of the literature about the effective school does not address the issue of multicultural curriculum.

And, therefore, an examination of the substance of what a prospective teacher needs to know before being given teaching credentials is critical. Teacher education can no longer be a detached, separate entity as though these changes are not upon us already. One cannot teach any longer without being philosophically touched by cultural reality and ethnic diversity. Teacher education has a history which must be confronted now. It has a history, a tradition, and an image. Very little, excluding increases in test scores and the number of tests, has been achieved in the last twenty years of teacher education.

The History of Teacher Education

Teacher education is broad and multifaceted. Every teaching certificate usually will require somewhere between 125 and 140 semester credits. (In the quarter system, those numbers are increased by one-third.) Teacher education has been woefully traditional and almost 100% Eurocentric, assuming that every student to be taught will be White, middle-income, and economically stable. So the courses, the readings, the clinical experiences, and the laboratory experiments have all been monocultural, monoethnic, monolingual, and completely void of the richness of the cultural and ethnic diversity which currently exists in our country.

American public education took its cue from the Boston Latin Grammar School in 1635, and many universities took their curriculum cues from Harvard University in 1636. Both of these programs were designed for an audience of males who were White, of European descent, from middle-income families, who had English as a first language, and who had no exceptionalities or handicapping conditions. Such basic curricular assumptions are now being challenged; and teacher education must deal with the transformation of human beings, including the human spirit and human ethics. At the same time, teacher education must transform itself to keep pace with the existing cultural understandings. Teacher education must move from a position of ethnic and cultural tolerance, limited perspective, and restrictive policies and behaviors to a position of *shared inclusiveness*. Teacher education should transform technique and skills into an equity level of humanity. This includes professional behaviors in

teaching, professional writings, instructional philosophy, curriculum policy and procedures, and a cultural sensitivity to diverse learning styles.

The Inadequacy of American Teacher Education

This discourse is designed to conclude that American teacher education is presently inadequate for the transformation of public education to a multicultural process. There is a glaring similarity across this country in the existing teacher education programs. The following is a little test for the American teacher candidate and the American teacher:

1. Name two Black playwrights.
2. Name two Mexican American historians.
3. Name two Native American writers or poets.
4. Name two Puerto Rican actors or actresses.
5. Name two female inventors or scientists.

Many teacher candidates are unable to pass such a test because their education (both precollege and college) failed to include such important information as a basic part of an American education.

It would be difficult to find a prospective science teacher who could not recognize a name like Jean Piaget or Isaac Newton. It should be easy to find culturally literate science teachers who can also produce a list of Native American scientists, African American scientists, female inventors, and Hispanic chemists.

Curriculum Bias and Instructional Discrimination

Adequate teacher preparation curricula involve the elimination of curriculum bias and instructional discrimination. Curriculum bias occurs in the practice of content selection, analysis, and utilization. If an American teacher is teaching science to a Vietnamese American student and fails to include Vietnamese scientists in the process, then that teacher (in an entire year) has engaged in curriculum bias, not only against that student, but against every student in that class. Further, the concept of *ancestral connectedness* is a major issue of multicultural teacher education and subsequently the public school curriculum.

Instructional discrimination occurs when instruction is delivered without a clear orientation to the students' cultures. It is the pedagogical act, practice, or behavior which discriminates against the various student learning styles. More specifically, it is the assumption that persons learn most effectively from listening to the teacher. Equitable instructional opportunity or equitable learning opportunity results when varied teaching approaches are employed to accommodate the various student learning styles (Boyer & Boyer 1975).

Curriculum bias is the inherent favoritism toward one economic or ethnic group over another. Such bias is usually reflected in textbooks, other instructional materials, standardized tests, and various artifacts which constitute the substance of school curricula. This bias exists when excluded groups are called on to respond as though they were included. It should be noted here that curricula is only the substance of learning, while educators are responsible for the form of that learning (Boyer & Boyer 1975).

A Friendly Confrontation

The idea being presented here is a friendly confrontation with something that socialized each of us as we grew up and as we experienced schooling in the American classroom under the guidance of a certified teacher. One of my friends in Pennsylvania says that we should stop telling children that Columbus discovered America, but tell them the truth: Columbus was LOST! (At some point, the truth arises.) The changing demographics of American schools must be the guide for future public education and, therefore, teacher education, including *science* teacher education.

This friendly confrontation must be addressed in elementary education, in secondary education, and definitely in teacher education. We are talking about something more than a 4-F Curriculum—foods, facts, festivals, and famous people—but a multicultural stand which embraces every facet of teacher preparation and development. In the 1970s, there was competency-based education. In the 1980s, there was a preoccupation with the Reform Movement. Today, we need multicultural reconstruction.

In this period of multicultural reconstruction, educators must begin to discuss major transformations within teacher education, so that the standard educational sociology becomes the sociology of teacher education, and the traditional educational psychology becomes the psychology of cultural-ethnic interactions. Educators must transform teacher education from traditional, monocultural field settings into field settings in which one studies cross-ethnic competencies. This transformation must pay deliberate attention to consumer satisfaction, encompassing ethnic growth and cultural and ancestral stimulation. It must also include the consideration of the development of a mentality of equity: ways of thinking and patterns of inclusiveness.

Analyzing Instructional Dynamics

Teacher education must now begin to recognize, analyze, research, and transmit those instructional dynamics which are present any time there is cross-cultural, cross-ethnic teaching and learning. When the teacher represents one culture or ethnic group, and the learners represent another, there are special elements involved in the instructional communication and learning approaches. Few, if any, of these have been mentioned, addressed, or researched. The preparation of teachers for such responsibility, however, must be based on such studies. These studies must involve a refined belief system based on academic justice, as well as social justice. These dynamics also must involve a new level of ethnic literacy, especially embracing African Americans, Native Americans, Hispanic people and Asian Americans.

Examples of these dynamics include: (1) ethnic perceptions of teacher toward learner, (2) ethnic perceptions of learner toward teacher, (3) ethnic and cultural history of the teacher, (4) learner perception of the compatibility of the learning experience with his or her cultural identity, (5) level of sensitivity incorporated by the teacher into the instructional delivery (cultural sensitivity, gender sensitivity, ethnic consciousness, and economic sensitivity), and (6) balance between the ethnic history presented in learning experiences and learner perception of that history.

The Goal: Multicultural Literacy

Today, equity in American schooling means multicultural literacy for all of our students. This can never be achieved until teacher preparation programs embrace multicultural literacy so that White teachers, African American teachers, Hispanic teachers, Native American teachers, Asian American teachers, and all of us who are engaged in the education profession work toward the same goal.

What is multicultural literacy? It is defined as a functional consciousness (knowledge and appreciation) of cultural, ethnic, linguistic, gender, and economic differences which are reflected in the larger society, but particularly in the academic marketplace of the world: the schools and classrooms where children are socialized. Persons who become multiculturally literate have a consciousness of human diversity and an appreciation for its existence. When multicultural literacy becomes an essential for teacher education, then those who come in saying, "I want to be a teacher," will know that they must come face to face with stereotypes, race relations, ethnic relations, language diversity, academic ethnocentrism, ethnic literacy, and the consuming ills of racism, sexism, elitism, ageism, and handicapism. Teachers can no longer speak of children who have some language other than English as a first language as children with a language barrier.

Many middle-class candidates for teacher education were socialized that however they did things was how "nice people do them." Such socialization could mean that when these candidates meet students, families, and other people who do things differently, they immediately assume that these people *aren't nice*. Multicultural curriculum experiences in teacher education would expose teacher candidates to people who do things differently and are both *adequate* and *nice*. School curricula (including university curricula for preparing teachers) are very powerful socializing elements. One's cultural history (gender history and economic history) has a great impact upon instructional delivery. Additionally, a person's geographic history impacts on their cultural perspective and their linguistic history critically impacts on instructional communication in classrooms, laboratories, studios, gymnasiums, clinical settings, and anywhere else communication occurs. Such historical dimensions must become part of teacher preparation.

Further, multicultural literacy is concerned about the content of the stories used to teach reading and language arts, the collection of books and nonprint materials in libraries and media centers, and the culturally influenced learning styles that every teacher ought to know. This extends to the ethnic literacy levels of educators in every school—particularly in the case where teachers must engage in disciplinary action with children across racial, ethnic, gender, and economic lines.

Some American Realities and Their Implications

In 1990, women with four years of college earned $11,221 less per year on average than men with the same amount of education (Snyder & Hoffman 1992d). Hispanic families had $11,922 less in income than White families (U.S. Bureau of the Census 1992d). In the 102nd Congress, 6% of the 435 members of the House of Representatives are women, 6% are African American, and 3% are Hispanic. Only 2 out of 100 senators are female, and none are African American or Hispanic (U.S. Bureau of the Census 1992b). Such realities can no longer be ignored in the delivery of instructional services. The general practices of political, economic, and other institutions must now be analyzed for their level of human equity. If America is to recover from its monocultural character, then teacher education must incorporate a consciousness of such inequities into the *required curriculum* for each science, mathematics, music, and elementary teacher, as well as every teacher.

Proposals for Inclusion in Teacher Education

The acquisition of a teaching certificate should mean that the candidate's preparation for teaching in public schools involves being able to adequately serve any learner. Such preparation should include the following: (1) Janice Hale's work as reflected in *Black Children: Their Roots, Culture, and Learning Styles*; (2) Ricardo Garcia's work as reflected in *Teaching in a Pluralistic Society: Concepts, Models,*

Strategies; (3) Howard Hill's work as reflected in *Effective Strategies for Teaching Minority Students*; (4) Luvenia A. George's work in *Teaching the Music of Six Different Cultures*; (5) Amos N. Wilson's work in *The Developmental Psychology of the Black Child*; (6) James Boyer's chapter, "Teacher Education to Enhance Equity," in H. Prentice Baptiste's *Leadership, Equity, and School Effectiveness*; (7) Jon Reyhner's work in *Teaching the Indian Child: A Bilingual/Multicultural Approach* (second edition), (8) Geneva Gay's work as reflected in "Ethnic Minorities Educational Equality" in *Multicultural Education: Issues and Perspectives* (edited by James A. Banks and Cherry A. McGee Banks); and (9) Susan Klein's work as reflected in *Handbook for Achieving Sex Equity Through Education*. These are but a few of the pieces of literature which could add to the effectiveness of American teacher education programs.

Excellence and Multicultural Education

Excellence cannot be obtained in these times without adequate attention to the population, environment, and literacy level of the teacher, the university curriculum, and the instructional delivery practices in American education. The elimination of racism, sexism, elitism, handicapism, ageism, and other social ills is essential to the goal of excellence in higher education. Until the universities' teacher education curricula *embrace differences* as basic to the American ideal, there will never be the level of excellence considered appropriate for an educated populace in the United States of America.

Multiculturalism implies a consciousness of human diversity, as well as *appreciation for the existence, growth, and development* of such diversity. It also implies a commitment to the elimination of *academic racism* in all of its manifestations. Academic racism exists when the practices associated with teaching and learning assume that the *intellectual* capability of a student, faculty member, or staff member is based primarily on one's race or ethnic identity. Academic racism also reflects an *imbalance* based on *instructional preference* which results in extremely limited learning about culturally and ethnically different persons, ideas, heritages, and events.

A Scientific Perspective

I want to offer the following ideas about the scientific endeavor, not as producer, but as a consumer. When I think of the scientific endeavor and the scientific academic community, I think not just of the technical aspects of science, but of scientific consumer literacy. The scientific community has made some strides in its goal to produce scientific specialists like astronauts. Where it has failed is in providing the consumers with a level of scientific literacy that makes it possible for each person to understand the importance of his or her existence and the preservation of our environment.

In 1990, White Americans comprised nearly 87% of the nearly 118 million members of the U.S. labor force. African Americans made up 10% of the labor force, while members of the other culturally groups constituted only 3% (U.S. Government Printing Office 1991). White males dominate the science labor force; of the science technicians in 1991, 29.8% were female and only 5.6% were Hispanic. African Americans made up only 6.6% of science technicians (U.S. Bureau of the Census 1992c), while they comprised 12% of the total U.S. population (U.S. Bureau of the Census 1992a). What is the legacy of Black scientists? How has the scientific advancement affected the Native American community? How do Native American people feel about science considering their commitment to nature and the earth? These are just a few of the questions connecting science and diversity which must be explored.

The increased use of controlled substances (illegal drugs) will force the scientific community to address ethics in the scientific enterprise. These ethical considerations will cover from organ transplants to the availability of scientific information, involving plagiarism, copyrights, and individual economic gain. Such scientific ethical literacy includes a consciousness of scientific safety with culturally diverse populations and in economically poor settings. The basic knowledge base, the philosophical positions, and teaching practices are but a beginning framework for the transformation of teacher education in America from monocultural to multicultural comprehensiveness.

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Equity and the Teaching of Mathematics

Walter G. Secada

A vignette from the *Professional Standards for Teaching Mathematics* (National Council of Teachers of Mathematics 1991) combined issues in the teaching of students from diverse backgrounds with issues in the preparation of preservice student teachers to teach mathematics. This vignette included a discussion about the techniques by which teachers should be able to reach all their students.

> Mr. Dreyfus opens the discussion by commenting, "Dilemmas are an inherent part of teaching. We may know what is desirable in term of theory, research, and expected practice, but often the route we take to achieve one goal is at odds with another. *What are some of this teacher's alternatives?*" (p. 150, emphasis added)

Later in the exchange, one student teacher responded:

> "It's hard to be attentive to all the needs of my students," notes Kadisha, who is working in a sixth-grade ESL[1] class. "I'm particularly aware of the students who have language difficulties. I give them a lot more attention than other students. Maybe the teacher in the article should try some small-group activities. Then she could walk around the room and spread out her attention." (p. 150)

Such treatment of issues involving teaching mathematics to all students is laudatory. It represents a good beginning in our efforts to ensure equity in school mathematics. Certainly this vignette shows greater sensitivity to the educational needs of linguistically diverse students than those found in the comments of an in-service mathematics teacher who argued that "I was taught how to teach mathematics, not how to teach *those* students."[2]

1. English as a second language.

2. Unless otherwise stated, the illustrative vignettes in this paper are taken from my more than ten years of work as a provider of inservice teacher training and staff

Over the past decades, we have progressed in discovering and refining some techniques by which teachers can more effectively reach more of their students. Take the insight of the preservice teacher in the vignette above. The use of small groups is very commonly recommended to teachers as an alternative to ability grouping and as a way of involving more students in classroom activities than would be involved through individual seat work. But also in small-group work, lies the danger that the work will be shifted to the group's most able students, thereby allowing other students to avoid doing their share of work. Hence, they do not learn. Teachers should monitor small groups to ensure that everyone is, in fact, participating in and understanding the mathematics; these reasons are why the group was formed in the first place (Cole & Griffin 1987; Webb 1989). Insights like these do represent real progress.

There are many worthwhile efforts for improving the participation and learning of mathematics by diverse learners. These range from programs for students to behaviors for teachers (Beane 1985; Campbell 1989; Casanova 1987; Cuevas 1990; Damarin 1990; Fennema 1987; Romero, Mercado, & Vazquez-Faria 1987; Secada 1990; Stiff 1990). There is much worth in solving commonly faced problems through the application of technique. However, researchers and practitioners alike need to remain aware of the concerns and issues that frame and provide meaning to those techniques. Thus, the purpose of this chapter is to advocate the incorporation of questions about equity in the teaching of mathematics beyond the technical.

In this chapter, I argue that teachers of mathematics make decisions based on their notions of social justice. I argue that those notions cannot be reduced to pedagogical content knowledge (Doyle 1990; Shulman 1986). Moreover, if we are to understand teacher

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development—first, as a staff member to, and then later, as the director of federally funded bilingual education training and technical assistance, resource centers. These centers were funded (and hence, my work has been supported) through grants and contracts from the Office of Bilingual Education and Minority Languages Affairs (OBEMLA), U.S. Department of Education. Support also has been provided by the Wisconsin Center for Education Research (WCER), University of Wisconsin-Madison. Opinions expressed in this paper are my own and do not necessarily have the endorsement of either OBEMLA or WCER.

decision making as it relates to the teaching of diverse learners, then we must try to understand teachers' notions of equity and ways those notions are linked to their other beliefs and knowledge.

The following narrative is divided in three parts. The first section contains a discussion of how I have defined *equity in education* (Secada 1989, 1991) and how that definition might be extended to the teaching of mathematics. In the second section, I provide an overview of work wherein *equity* is defined from a more technical point of view, as in the case of compensatory education programs whose purpose is to achieve equality of educational opportunity. And in the third section of this chapter, I present a discussion on how the notion of equity that I am proposing provides a different way of understanding teacher decision making other than asking simply whether or not teachers faithfully implement programs as they were designed. In that section, I also discuss that teachers actively shape programs according to their views of what is just and fair and argue that their shaping of those programs has a direct impact on how programs get implemented in the classroom. This chapter ends with a discussion of how research that is grounded in trying to understand teachers' notions of equity might proceed.

Equity

Legal notions of equity date back to Aristotle; more recent British and American traditions of equity jurisprudence are:

> There are two kinds of right and wrong conduct towards others, one provided for by written ordinances, the other by unwritten.... The other kind [the unwritten kind] has itself two varieties... [of which the second variety] makes up for defects in community's written code of law. This is what we call equity; people regard it as just; it is, in fact, the sort of justice which goes beyond the written law. (Aristotle 1981, pp. 63-64)

Thus equity is an appeal to justice beyond the letter of a law. Law is an effort to codify what a society believes is just. Consequently, law dictates what ought to be done. Equity is based on recognizing that no law can anticipate all possible events to which it might be applied. Equity functions to check a law's application directly against notions

of justice. It serves to ask the question, "Yes, this is according to the law, but is it just?" While notions of justice have changed and evolved over time, equity has remained a check on the applications of law directly against then-current notions of justice (McDowell 1981).[3] And moreover, through its links to notions of social justice and of law, equity is constantly evolving.

Equity in Education

Equity in general can be thought of as something that can be used to check how social arrangements—of which laws are but one sort—function directly against applicable notions of social justice or fairness. Equity in education refers to the scrutiny of social arrangements that undergird schooling to judge whether or not those arrangements are consistent with standards of justice.

Social Arrangements. Rather than being under the scrutiny of only the codified practice (as in the case of law), equity in education should be focused upon the larger domain of social arrangements in education. Certainly, there is much in education that is codified, ranging from a school's procedures and written codes of conduct to its curriculum guides and the materials teachers use. Indeed, a very common equity debate concerns the representation of people from diverse backgrounds in texts. Not only are there concerns about how often different kinds of people are found in those materials, but also there are efforts to have them represented in nonstereotypical ways.

On the other hand, the social arrangements in education are more than what is written. They include a broad range of practices that are based on individual and shared beliefs—both tacit and explicit—

3. For example, during ancient Greek times, justice consisted of the natural order of things, and equity was based on the claim that a law's particular application went against that natural order. In early British times, divine justice was thought to be reflected in human affairs through the king. Equity was an appeal to the king's conscience that he check how his law was being applied against standards of divine justice. In the United States, legal standards of justice are thought to be enshrined in the Constitution as it is interpreted at a given time. Ultimately in this case, equity is an appeal that a law's application is unconstitutional.

that things should proceed in a certain way. This complex web of beliefs and behaviors is enacted by different players, among them parents, administrators, teachers, and the various publics who have opinions about and exert pressure on schooling. Since these practices impinge on the education of diverse learners in ways that we are only now beginning to understand, it would not make sense to restrict inquiry to only that which is codified.

Standards of Justice. Equity in education acknowledges that social arrangements are in place in an effort to achieve desirable ends. For example, curriculum is predicated on the belief that there is knowledge of such worth and that it should be granted the privileged status of being something that our students should learn about and know. Even acknowledging the desirability of the goals that these social arrangements are intended to achieve, equity in education allows us to gauge those arrangements directly against evolving notions of justice.

Equity Versus Equality and Socially Enlightened Self-Interest

In some previous works, I have argued that we need to distinguish between equity in education and two other related, albeit distinct notions—equality of educational opportunity (Secada 1989) and socially enlightened self-interest (Secada 1991).

Equality of educational opportunity usually refers to efforts to ensure that diverse groups of learners, in the aggregate, are treated the same (i.e., equally) at one of three junctures in the educational system—its inputs, processes, or outcomes (Brookover & Lezotte 1981; Coleman 1967, 1975). Efforts to achieve equality between groups at one of these junctures is commonly thought of as representing efforts to achieve equity. For example, efforts to achieve parity between boys and girls on spending for sports are at the inputs level; while efforts to close the mathematics achievement gap between Asian Americans and Whites on the one hand and African Americans and Hispanics on the other are at the outcomes level (see Fennema & Meyer 1989).

Notions of socially enlightened self-interest also undergird much of the concern about the mathematics education of diverse learning

populations. By enlightened self-interest, I mean concerns predicated on the realization that the demographics of our student populations are changing and that with those changes will come, inexorably, changes in the make-up of this country's work force (Hodgkinson 1985; National Alliance for Business 1990). Tied to demographic changes are changes in the levels of mathematics and science literacy that will be needed in order for people to participate in any meaningful way in the economy and the work place, as well as in the society and its most cherished democratic institutions (Secada 1990, 1991). Hence, if ever it could, this country no longer can afford to educate a few elite while neglecting or at best training the balance of its youth for low-skilled jobs that will no longer be available in the next century. The consequences of such undereducation will be disastrous.

Both equality of educational opportunity and enlightened self-interest embody rich traditions of thought. They provide compelling rationales for concerns about the education of diverse learning populations. But we need to understand how writings and programs that have been grounded in these other two conceptions would proceed and lead to the interpretation of results in ways that would be problematic, if not contradictory, in comparison to writings and programs that are grounded in equity as a concern for social justice.

One strength in this approach of looking at equity in education as an issue of social justice is that it forces those of us who operate from such a stance to become clearer on the standards of justice that we are using. There are many social arrangements in schooling, just as there are in everyday life. But not all of them, indeed only a few of them, can be problematic at a given time.

The justice claims used by those who are concerned about the equity of a certain state of affairs may be tacit. But this conception of equity allows us to inquire about the bases for such concerns and to make them explicit.

The common sense observation, that what is inequitable is unfair, provides a start for such inquiry. People are often motivated by a sense of fair play. Though notions of social justice are still not as explicit as I would like them to be, inquiry about how people see fairness in educational practices serves as a useful point of departure.

Teachers of Mathematics as Implementers of Programs to Achieve Equity

From the equality of education paradigms have come many efforts to promote more equitable distribution of resources among our nation's children. However, one of the lessons learned from the *Equality of Educational Opportunity Survey* (Coleman *et al.* 1966) was that an equal distribution of resources does not result in equal educational outcomes. In partial response to these findings, the federal government set out on what has become an almost thirty-year effort to equalize the outcomes of education, in the aggregate, among groups based on lines of ethnicity, gender, and social class. Though debates have raged about how best to achieve this goal, it has been a constant concern that has recently returned to the fore.

It is important to recognize that these efforts have been grounded in a variety of ways. At first in the 1960s, issues tended to be framed in terms of desegregation and cultural deprivation. Over the past thirty years, the discourse has revolved around notions of cultural mismatch, feminist and critical theoretical views, effective schools and instruction, excellence in education, and most recently, education for all. However, common to all of these views has been the assumption that what is equitable has been decided. The only remaining problem was technical—i.e., for the teacher to implement faithfully programs that were intended to increase educational achievement and course taking among underrepresented groups of students.

Programs

Among the many programs for improving the mathematics achievement of diverse groups are the compensatory education programs that date back to the Great Society—Title I of the Elementary and Secondary Education Act (ESEA, now Chapter 1) and Bilingual Education (formerly ESEA Title VII). Evaluations of such programs have concluded that they succeed in improving achievement among children who enroll in the programs as compared to similar children who do not (Secada 1992).

Improvement among poor, low-achieving students who are enrolled in Chapter 1 programs is greater in mathematics than in reading, possibly because Chapter 1 mathematics is in addition to regular mathematics, while time spent in Chapter 1 reading is at the expense of class time that would have been spent on reading anyway. After all, most of the elementary school day is spent on reading.

Chapter 1 effects seem limited to basic skills and are short-term. Children's performance drops over the summer months; so that, while they are still achieving somewhat better than children who are not enrolled in Chapter 1, their relative gains are much smaller than their gains were at the end of the school year. After they exit Chapter 1 programs, children's gains eventually dissipate so that within a few years there are no differences between them and children who never enrolled in such programs in the first place (Kennedy, Birman, & Demaline 1986). Though Limited English Proficient (LEP) students are better served by being enrolled in bilingual education programs than not being in these programs (Willig 1985), we do not have comparable data to that which is available for Chapter 1.

A feature common to both Chapter 1 and bilingual education that is thought to account for their beneficial effects—even if they are short-term—is the use of direct instruction (Kennedy *et al.* 1986; Tikunoff 1985). Direct instruction prescribes teacher behaviors including the clear structuring of lessons, provision of overviews and reviews of materials, highlighting of main points, time spent on teacher-led development of a lesson, and decreased time on individualized seat work (Brophy 1991). What is not clear is how such behaviors should be organized to be driven by specific teacher goals as described by Tikunoff (1985), or if they must be scripted in as great a detail as the case for Active Mathematics Teaching (Good, Crouws, & Ebmeier 1983). In recent work, Brophy (1991) has recommended that the teaching of poor students incorporate more high-level activities, substantive conversations, and less attention to breadth, while increasing depth of content coverage.

In addition to compensatory programs, there are programs designed to encourage students to take additional courses and to persevere in pursuing mathematics and science related careers (reviewed by Campbell 1989). Common features of these programs are

that they are out-of-school, engage students in activities, expose them to the usefulness and possibilities of careers in mathematics and science, and are fun.

Teachers and Teaching Behaviors

Not only has there been research on the instructional features of successful programs, there has been research on what teachers can do to improve achievement and to encourage students from diverse backgrounds to persevere in taking mathematics and science courses. For example, research on dyadic student-teacher interaction has found that teachers and students engage in systematic behaviors that are differentiated along lines of ethnicity, gender, social class, and language. Much of that research has linked such differentiated behavioral patterns to differential patterns of achievement.

For example, in her review of the literature on sex-related differences in mathematics, Fennema (1987) noted that boys have more interactions with teachers than do girls. Boys initiate more contacts and receive more discipline as well as praise from their teachers. Boys are criticized more for lack of effort, while girls are criticized for the academic quality of their work. Similar patterns of differential behaviors between teachers and high-achieving boys and girls have also been documented in the literature. Peterson and Fennema (1985) found that competitive activities were negatively related to fourth-grade girls' low-level (basic skills) achievement in mathematics; while cooperative activities were positively related to both low-level and high-level (problem solving and applications) achievement. For boys, competitive activities were positively related to low-level achievement, though in absolute terms that relationship was less than the negative relationship for girls. Cooperative activities, on the other hand, were negatively related to high-level achievement for boys. Peterson and Fennema suggested that one way out of this conundrum would be to use activities that combine both cooperation and competition (e.g., cooperative group team competitions) or activities that rely on neither.

According to Campbell (1989), teachers who are successful in encouraging their female students to persevere in taking courses

engage in some rather purposeful behaviors. They use laboratory and discussion activities, provide career information, directly involve girls (and by extension, students from underrepresented groups in mathematics) in activities, provide informal academic counseling, and demonstrate unisex treatment in the classroom. Equally important, these teachers refrain from other behaviors: use of sexist humor, use of sex-stereotyped examples, distribution of sexist materials, allowing boys to dominate discussions, and allowing girls to passively resist.

Summary Comments

These lines of research on what works for improving the achievement of students from diverse backgrounds have yielded valuable insights into how we might achieve equality of educational outcomes. However, what is not known about such work is whether or not so-called effective practices will help close the gap. Nor for that matter, do we know which "effective practices" are likely to have long lasting effects—i.e., just because we close the gap, does it remain closed? Research is needed to answer these two questions. Also, research is needed to ensure that the reform movement does not result in the exacerbation of existing disparities (Secada 1992).

Finally, note how issues of equity have become purely technical issues within these lines of research. Having settled upon the goal, research is only to identify those techniques that work. Teachers are expected to implement faithfully those techniques.

Teachers of Mathematics as Equity-Seeking Decision Makers

Consider the case of a middle-school mathematics teacher, in an urban school, who supervised the school's computer laboratory, bought through Chapter 1 monies. Due to district-wide budget cuts, the laboratory was open for a single period a day and then only for students who received Chapter 1 services.[4] In partial response to those cuts, this teacher developed an attendance policy: to enroll in the

4. This was before Chapter 1 monies could be used to support school-wide efforts.

computer lab, students had to have come to school a minimum number of days the previous term. The upshot of this requirement was that Chapter 1 students would still use the computer lab, but the school's lowest-achieving students—i.e., those most in need according to Chapter 1 criteria—were effectively barred from the laboratory.

From the perspective outlined earlier in this chapter where the teacher's role is to implement a program as it is given, this policy is very troubling. According to that view, the teacher should do the best job under the given conditions. A supervisor would object to how this teacher had short-circuited the proper implementation of Chapter 1 services to that school's most-in-need students. That supervisor would take steps to disallow the new policy.

Alternatively, were this policy to become a topic for discussion in a methods course (as in the NCTM [1991] *Teaching Standards*), one could envision an exchange focused on the technical aspects of the decision. Might this teacher have found ways of enticing these students to come to school by selecting computer activities that were more challenging and more appealing than those students otherwise encountered in school?

Such analyses, however, overlook why this teacher established this attendance policy in the first place. The computer laboratory's limited hours of operation made it a very scarce resource. The teacher thought it unfair that students who "cut" school would be enrolled for the single period that it was available, thereby wasting a valuable resource. It seemed patently unfair that the lab would go unused, while other students, who were from similar backgrounds, were denied access. It seemed even more unfair that high-achieving students, who would benefit the most from access to the lab, were barred from it and that there was nothing to be done about that. Would it not be more fair, noted this teacher, that students who came regularly to school and who would therefore use the computer lab when it was open should have access to it?

This teacher's attendance policy was an effort to redress what was to him a miscarriage of justice. Also, he could not believe that this was the way the program was intended to work. Though unable to do anything for the school's high-achieving students, at least he could take steps to ensure that the lab was not totally wasted on students who did not come to school regularly.

There may be some debate about this teacher's reasons and actions.[5] But those actions were in an effort to shape the application of a particular program to a particular setting. He argued that the program's designers could not have intended for it to function as it would have otherwise.

Recall the earlier discussion about the nature of equity in mathematics education as that by which we gauge social arrangements for the teaching of mathematics directly against notions of social justice. That is precisely what this teacher did, albeit against his own personal notions of social justice. Moreover, the program (i.e., the arrangement) was modified in light of that assessment.

This teacher's notions of fairness were triggered by two additional considerations—the scarcity of a valuable resource and the efficiency of the current allocation of that resource. Were the computer lab available throughout the school day or were the then-current arrangement to have worked as it should have, it seems unlikely that this teacher would have acted as he did. Moreover, his policy was based on the interplay of these concerns. For example, were concerns for efficiency primary, this teacher would have shaped his policy so that those students who would have profited most from using the computer lab—i.e., the school's high-achieving students—would have gained access at the expense of everyone else.

Nor was this practice, strictly speaking, a case of educational triage. If it had been, the teacher would have decided who could not have benefited from the lab, who could have, and who did not need such access. Under such conditions, high-achieving students are typically thought not to need additional resources. But this teacher was troubled that there was nothing he could do for them.

The point is this: This teacher's decision was based on his assessment of a complex set of circumstances, not on the mindless application of some general rules. In many interactions that I have shared with mathematics teachers, I have become convinced that much of what they do in the teaching of diverse learners is predicated on similar, complex notions of equity. I would hypothesize that these decisions are made based on teachers' notions of what resources they actually control and how they try to allocate those resources efficiently

5. I myself remain uncomfortable with this policy.

and fairly. Moreover, teachers will modify what others intend for them to do based on those notions.

Control of Resources

What resources do mathematics teachers control? Minimally, it would seem that they can act alone or in concert with other teachers; and thereby they can control student access to their classrooms, to a range of material resources in the school, and more subtly, to their own time and the kinds of interactions that they have with their students. In all of these areas, teachers of mathematics allocate resources based, at least in part, on their efforts to be fair.

Access. The first step to a resource is access, not only to a program as in the case above, but also to courses as in the case of tracking and ability grouping. At the most personal level, access can extend to a teacher's own classroom. Consider what a mathematics teacher said to me about having LEP students in class:

"There are some teachers here [in the school district] who like having those [LEP] students their classrooms. They even come to these workshops willingly. Couldn't we fix things so that they get all of those students?"

Obviously this teacher did not want LEP students in his classroom. He would have been happy were they not there, and in large part, was angry because he could not control who was placed in his classes. Explicit in this comment is the desire for an arrangement wherein he does not have to face any LEP students.

Alternatively, there is a rich folklore about teachers who actively seek out diverse learners for their classrooms. In almost every building, one hears of the teacher whose class grows over the course of the year as she or he willingly accepts new students—be they immigrants, students who have exited from a categorical program elsewhere in the school, or new transfer students. In my conversations with some of these teachers, I have found they have a zeal and set of strongly held beliefs about their roles in empowering such students who would be otherwise abandoned. Campbell (1989) interviewed a preschool

teacher who had participated in a program to provide mathematics and science experiences to very young children of color. She explained that:

"The media were saying so many American kids were not learning science and mathematics. When I read the article I thought, 'What can I do?' [The project was] a chance we could do something. It gave me a better feeling." (p. 109)

Planning and Interactions. Access goes beyond entering the doors of a classroom. Teachers control who will teach and the in-class conditions under which they will do so. For example, one teacher asked me, "Why should I work with those [LEP] students, when many of ours need my help even more?" Furthermore, he noted that the LEP students in his classes received help from the school's bilingual program while many of "our" students had no one else to help them.[6] This teacher had decided who he would and would not teach. His justification was couched in highly problematic terms of "us versus them;" but, it suggests that he was trying to redress an injustice by withholding help from one group of students and giving that help to others.

While teaching, teachers seem to engage in some very purposeful interactions with their students. Stanic and Reyes (1986) provided an extensive case study of a seventh-grade mathematics teacher who engaged in very purposeful and differential patterns of interactions with his students, based on their own ethnic and gender group membership, as well as on his own experiences as an African American male. For example, he criticized an African American male who was a good athlete in order to keep him from falling into the athletic syndrome of not trying.

Notions of Justice

These teachers based at least some of their decisions on more than their notions of whether or not a particular strategy were working. They believed that they were acting in an effort to be fair. The teacher in charge of the computer laboratory and the teacher who questioned why LEP students had access to resources that other students did not

6. This school's Chapter 1 programs had been cut drastically due to the consolidation of funds at the start of the Reagan administration.

have, both believed that they were righting injustice. The first teacher based his judgments on the injustice being visited on students who might have profited from access to the computer lab; the second, on his notion that there was an unequal distribution of the resources in his classroom. Other teachers may base their ethical judgments on their own personal experiences and include proactive efforts to spare students from similar backgrounds those fates, as in the case of the teacher studied by Stanic and Reyes (1986). Finally, teachers may work from an altruistic sense of justice, as in the case of the teachers who welcome and actively recruit students from diverse backgrounds into their classrooms.

The situations where teachers deny or fail to claim an ethical or moral dimension to their efforts are just as important as those who do include such considerations. This situation may happen when teachers see what they are doing as purely a technical problem without questions about unintended effects being issues.

Where teachers are disempowered, there can be no questions of equity. For example, anyone involved in staff development efforts can tell stories of teachers who respond to everything that is suggested with, "That won't work," or as one teacher so bluntly put it, "I was taught to teach mathematics, not those [LEP] kids." If there is nothing that one can do, then there can be no moral or ethical dilemma.

Concluding Comments

There is an ever growing research literature on teacher thinking and decision making, much of it based on studies of mathematics teachers. In that research, there can be found much on teachers' knowledge and beliefs about their students (e.g., expectations), about content (e.g., the nature of mathematics), about pedagogy (e.g., whether algorithms should be the center of instruction), and about their planning and classroom decision making (Clark & Peterson 1986; Grouws & Cooney 1988; Peterson, Fennema, & Carpenter 1991; Shulman 1986). But that research has failed to grapple with how teachers deal with their students as a function of diversity.

Research has provided some rich descriptions about ways teacher behaviors are constrained by their understanding. Mathematics

teachers will teach an idea based on how they understand that idea. If their knowledge is limited, so is their teaching. Teachers who believe that basic skills precede problem solving will plan and structure their lessons accordingly; while teachers who have different beliefs are more likely to focus on problem solving as the content of their instruction (Peterson *et al.* 1989; Peterson *et al.* 1992). What this research has not helped us understand, however, is how mathematics teachers deal with issues of students' diversity.

I hope to have built the case that teachers are motivated, at least in part, by concerns that can be described as based on equity. These concerns arise as part of their practice, as they must come to grips with how they will distribute the scarce resources that they control among their students. I have argued that these beliefs and judgments are part of the reason why programs and other initiatives that are intended to foster equality of educational opportunity are modified.

This is not meant to lessen the importance given to questions about how teacher knowledge, beliefs, planning, and decision making have impact upon their classroom actions. But the accounts revealed in that research fail to inform us as to why teachers behave in differential ways with the diverse student populations that they encounter every day.

What is needed is a more elaborate picture of teachers' knowledge, beliefs, judgments, and decisions as they apply to their diverse student populations and as related to their notions of equity. As we get a better picture of those cognitions and how they interact with other beliefs, we will have a more elaborated view of the teaching of diverse learners. What is more, we will be better able to enlist the help of teachers in achieving equitable teaching of our diverse student population.

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3

Moving Toward Culture-Inclusive Mathematics Education

Patricia S. Wilson
Julio Cesar Mosquera Padron

Mathematics is a human endeavor and therefore is influenced by the cultures of its creators. The mathematics that is used, studied, accepted, rejected, or preserved is dictated by culture. Mathematics has been characterized as the science of pattern (Steen 1990), and these patterns reside in the viewer's mind and are influenced by the context of the patterns and the culture of the viewer. When mathematics is viewed as a cultural artifact or an element that is socially constructed, the nature of mathematics education changes. We propose that culture-inclusive mathematics education is an important component of multicultural education and may provide a useful approach for other disciplines.

Culture-Inclusive Mathematics and Its Relationship to Multicultural Education and Current Alternatives

In the United States and in many other countries, the debate about multicultural education is one of the major issues in education today. Many journal monographs, special issues of popular magazines, books, meetings, newspapers, conferences, and academic seminars have been recently devoted to issues involving multicultural education. The publication of this book could also be considered as a sign of the growing interest about multicultural education among scholars in different fields. Moreover, many universities and colleges around the United States are offering courses on multicultural education as part of their regular education curriculum. Multiculturalism in education could be characterized as an effort to substitute a more pluralistic view of the world in place of the prevalent Eurocentric view. There is not, however, a consensus on what multicultural education means and

what direction multicultural education reforms should take. In fact, multicultural education encompasses many approaches, such as curriculum reform, teacher education, and equity. James A. Banks (1989) recognized the complexity of the issue when he claimed that the only way to achieve a truly multicultural education is to change the entire school system. He pointed out that multicultural education is at least three things: "an idea or concept, an educational reform movement, and a process" (p. 2).

The current discussion on the best approach to education in a multicultural society also includes alternatives to multicultural education. Consider the following three alternatives: the "Great Books," the Afrocentric, and the "Middle Ground." The Great Books approach to education is well known and it has been revived recently, by the publication of a book by Bloom (1987). The three basic principles behind this approach are: (a) There is a universal culture, (b) everyone living in the West should be acculturated into it, and (c) there exists a list of "Great Books" containing that culture.

The Afrocentric approach is a more recent movement. Afrocentricity has been defined as a curricular movement which focuses on Africa as the center of study or on looking at the world through African eyes (Magner 1991). At its beginnings, the Afrocentric idea was restricted to an interpretation of history and to a way of approaching Black Studies. Molefi Kete Asante characterized Afrocentricity as "the attitude of viewing phenomena from the standpoint of the African person as subject rather than object," and he emphasized that Afrocentricity is "not a biological concept. It's not a racial supremacy idea" (quoted in Magner 1991, p. A13). Afrocentrism, or Afrocentricity, is gaining support from educators, especially Black educators, at different school levels.

A third alternative, the Middle Ground, has also been developed recently and is an alternative to both monocultural and multicultural approaches. One example of the Middle Ground is the University of Arizona's course offering titled "Critical Concepts in Western Cultures" which is part of a new series of humanities courses. The main purpose of this course is to look at ideas traditionally associated with Western civilization from diverse and different cultural perspectives (Mooney 1991). This alternative could be seen as part of

the cultural studies movement. This is "a growing movement in academe that reaches across humanities and social science disciplines to examine how cultural assumptions are formed" (Mooney 1991, p. A10).

Proponents of multicultural education and various alternatives have rarely regarded mathematics education as an intellectual arena in which cultural issues are important. If mathematics educators were to adopt a narrow perspective, such as the Great Books approach or the Afrocentric approach, large portions of mathematics would be ignored. For example, a Great Books approach to mathematics education would omit consideration of the contributions of many civilizations, such as the Islamic contribution of algebra or the Mayan concept of zero. An Afrocentric approach would fail to recognize the contribution of the French philosopher Descartes. Multicultural education certainly offers mathematics education an approach that values diverse cultural contributions, but it often fails to acknowledge the constructivist perspective of mathematics education research. For example, multicultural education's emphasis on learning styles is not consistent with a constructivist approach (Cobb 1989).

We argue that mathematics education needs a different approach. This approach must incorporate the multicultural, Afrocentric, and middle ground concerns for equity issues in education and must also consider research knowledge from mathematics education and related disciplines that recognizes the important role of culture and context. We call this approach *culture-inclusive mathematics education*.

Culture-Inclusive Mathematics Education

The term *culture-inclusive* was introduced by developmental psychologist Jaan Valsiner (1989). Valsiner used the term culture-inclusive to refer to a psychological perspective that studies human development in the culturally constituted contexts in which it occurs. From this perspective, culture cannot be reduced to the role of a variable, as it is frequently used in cross-cultural research. For us, the term *culture-inclusive mathematics education* refers to mathematics education that

looks at the development of mathematical thinking in the culturally constituted contexts in which it takes place. Since mathematics education is a discipline that is concerned with teaching and learning as well as research, we wish to extend Valsiner's classical approach to developmental psychology research to mathematics education. We envision a culture-inclusive mathematics education that is concerned with improving mathematics education for all pupils in a way that respects their cultural backgrounds and prepares them to be active participants in the socio-cultural environment in which they are growing up.

Mathematics educators working from a culture-inclusive perspective acknowledge that mathematical thinking is influenced by the conditions in which it occurs. We also claim that all mathematics and mathematics education are culture-laden. For example, group theory of algebraists is not less cultural than the mathematics of the peasants from Botswana, and the teaching of mathematics in White middle-class neighborhoods is not less ethnic than the mathematics education of Mozambique or the Watts area of Los Angeles. These assumptions about the cultural character of mathematics and mathematics education have far-reaching consequences. Mathematics educators, then, should be sensitive and responsive to both the characteristics of the contexts in which mathematics teaching and learning take place, and to cultural influences on mathematics. Mathematics educators should reflect on these two aspects regardless of how many different cultural groups are represented in the classroom. This view is important for demystifying the idea that only the education of "the other," also called "the colored" (Hispanic, Black, Asian, and so on), is affected by culture. We think that all students would benefit from learning about other cultures and their mathematical ideas. A mathematics curriculum should reflect the cultural diversity of today's world, regardless of how homogeneous the target population is. From our perspective, all pedagogical actions are influenced by culture: for example, by the culture of the learner, the culture of teaching, and the culture implicit in the organization of the content.

A cultural-inclusive approach to mathematics education needs to include the study of the cultural contexts in which mathematical education takes place, analysis of the mathematics produced in

different cultural contexts, study of mathematical activities, review of conceptions of mathematics, and review of currently held notions in research in mathematics education.

The Nature of Mathematics

One of the starting points for developing multicultural mathematics education is to seriously examine what we consider to be the nature of mathematics.

The idea that mathematics is a cultural element or that it is affected by cultural forces is not new (Keyser 1947; Spengler 1926; Struik 1942; White 1947; Wilder 1952). It has been revitalized by the work of some sociologists of mathematics (Bloor 1976; Restivo 1983), anthropologists (Ascher & Ascher 1972), and some authors within the mathematics education community (Bishop 1988; D'Ambrosio 1985b). Despite this work, culture-inclusive mathematics is not a mainstream idea among mathematics educators or even among those interested in developing a multicultural mathematics.

Multicultural mathematics education should be based on theoretical and practical issues that include more than the currently popular issues, such as learning styles, teaching styles, the use of the history of mathematics, and the use of cultural elements in teaching. The implementation of multicultural mathematics education requires serious consideration of one's ideas about the nature of mathematics and the impact of those ideas on mathematics education. As Keitel (1986) said,

> changes in mathematics education need to challenge fundamental assumptions about the nature of mathematics or else remain marginal in effect. (p. 20)

Mathematics education is influenced by the ways in which mathematics is conceptualized. That is, mathematics educators' (e.g. teachers, curriculum developers) views of mathematics influence their presentations of mathematics as well as their conceptions of how pupils learn. In the following two sections, we will present various conceptions of mathematics held by philosophers, mathematicians,

sociologists, and mathematics educators. The purpose of these sections is not to present a review of the literature in either area, but to present those works that are relevant to culture-inclusive mathematics education.

Recent developments in the philosophy of mathematics question the traditional views. Among these developments, that of Lakatos (1976) and that of Davis and Hersh (1980) have become the most popular. Lakatos' philosophy of mathematics is known as *falibilism*. Based on the ideas of his mentor, Karl Popper, Lakatos claims that mathematical growth is the product of a process of proofs and refutations. For him, mathematics is a human activity. Mathematics is seen as the product of human minds, rather than something that exists somewhere to be discovered. This view was rooted in earlier discussions. As early as 1848, John Stuart Mill (cited in Bloor 1976) proposed an empiricist interpretation of the nature of mathematics: that is, a view in which mathematical knowledge was conceived in experience. In 1947, the mathematician Keyser, based on the ideas of the German philosopher Oswald Spengler, presented his culture clue hypothesis. In his approach, he claimed "to begin by viewing mathematics as a way of thinking" (Keyser 1947, p. 3).

The ideas of mathematics as the product of experience and as a human process have been developed more recently in a popular book by Philip J. Davis and Reuben Hersh (1980) entitled *The Mathematical Experience*. In this book, Davis and Hersh claimed that mathematical creation is not just a matter of individual activity but that society should be taken into account as well. They argued that the social and cultural perspective of the study of mathematical growth is not easy to understand or pursue. They even wondered whether it is possible to write a history of mathematics from this perspective. In conclusion, they emphasized the importance of considering the interplay between individual and society and stated that a perspective omitting either one is incomplete.

Lakatos' (1976) view of mathematics and Davis and Hersh's (1980) interpretation of it have influenced mathematics education. This influence can be specifically found in recent documents advocating curriculum reforms in mathematics, such as the National Council of Teachers of Mathematics' (NCTM 1989) *Curriculum and Evaluation Standards for School Mathematics* and the National Research Council's

(NRC 1990) *Reshaping School Mathematics: A Philosophy and Framework for Curriculum*. These approaches to mathematics represent an advance towards a culture-inclusive interpretation of mathematics. However, they are not enough; further development is needed.

Developments in the sociology of mathematics can also provide guidance in developing cultural-inclusive mathematics education. D. J. Struik (1942) introduced the use of the concept *sociology of mathematics*, defining it as the discipline that:

> concerns itself with the influence of forms of social organization on the origin and growth of mathematical conceptions and methods, and the role of mathematics as part of the social and economic structure of a period. (p. 58)

Since the publication of Struik's paper, the sociology of mathematics has taken a variety of paths. We will restrict ourselves to the works of David Bloor and Sal Restivo. Contrary to earlier sociologists, Bloor (1976) claims that mathematical knowledge can be subject to sociological analysis. Moreover, he claims that:

> sociology along with psychology can furnish an adequate approach to the nature of mathematical knowledge and logical thought. (p. 77)

One of the most important points in Bloor's approach to the sociology of mathematics is his claim that there could be an alternative mathematics. Bloor asked himself the question of what an alternative mathematics would look like. The answer, he says, seems obvious: it "would look like error or inadequacy" (1976, p. 95).

Restivo's (1983) approach to the sociology of mathematics has as its starting point the work of Oswald Spengler. He assumed Spengler's view that mathematics can be explained in terms of the particular social and historical forms in which it is produced (Restivo & Collins 1982). Restivo summarizes Spengler's position into two basic propositions: (1) "There is not, and cannot be, number as such" —there are several number-worlds as there are several cultures; and (2) "There is no mathematic but only mathematics" (p. 277).

Restivo introduced the concept of *epistemic strategy*. An epistemic strategy is not concerned only with the nature of knowledge, but also with the social environment in which thinking takes place. Therefore,

researchers working from this perspective are not only interested in understanding how social contexts influence the way in which people think; they are also interested in improving the conditions in which the thinking takes place.

A culture-inclusive approach to mathematics education could then be characterized as an epistemic strategy. Mathematics educators working from this perspective are not only interested in understanding the interactions between the development of mathematical thinking and the cultural context in which this development occurs; they are concerned with the improvement of the material conditions in which children's and adult's mathematical thinking is developed.

The sociology of mathematics offers complementary elements to the psychological approach to mathematics that are relevant for developing culture-inclusive mathematics education.

Making Changes in Mathematics Education

Historically, school mathematics has consisted of a limited and rather elitist curriculum. Most mathematics courses have been designed to prepare students for the next mathematics class with the promise that eventually this recurrent process will lead to superior intellectual ability and abstract thinking. These goals have some merit, but they do a disservice to the field of mathematics and certainly to the mathematics student. Mathematics is an area of study that is rich in culture, history, applications, and even frivolity. It is the creation of people and has been shaped by their needs, politics, rituals, perspectives, and efforts to interpret nature. Unfortunately, school mathematics is often presented as a static body of knowledge to be mastered for an exam, leaving it devoid of character and supporting the erroneous notion that mathematics is for the elite few who are "capable."

Recently there has been a change in rhetoric with numerous reports and positions proclaiming mathematics is important for all students (e.g., NRC 1990; NCTM 1989), but these reports still do not acknowledge the culture-inclusive nature of mathematics. The current argument contends that all students need mathematics to be useful citizens. They need to be able to participate in our technological society, reason and communicate quantitatively, and act as produc-

tive members of the work force. Again, these goals are credible. It is encouraging that there is widespread recognition that mathematics does not belong to an elite population and should be a part of everyone's basic knowledge; but the utilitarian approach to mathematics still excludes the creative, exciting, and dynamic nature of mathematics. Unfortunately, the exclusion of certain components is not just a matter of overlooked content. It has a severe impact on learners' depth of content knowledge and their ability to use that knowledge. Mathematics is a human endeavor with all the creative characteristics of literature, art, and music.

Schools are trying to provide mathematics for all students through essentially the same practices that have reduced the subject to preparation for the next mathematics class with little relevance to daily living. Students are still placed in tracks, textbooks have essentially the same format and content, curriculum guides are lists of mathematical topics, and teachers' lesson plans consist of exercises to be assigned and textbook pages to be completed. The problem is extensive and can and should be approached from several perspectives, but we would like to focus on the power of teachers and teacher education programs to make a difference. Although it is exceedingly difficult, creative, knowledgeable teachers can overcome limited texts, weak curricula, and restrictive classroom artifacts such as tracking, extensive testing, or the 50-minute class period.

If teachers are to take on the enormous task of providing a more culture-inclusive mathematics, teacher education programs must help them prepare for this task. They must offer both inservice and preservice programs that recognize cultural contributions to mathematics and celebrate the richness of mathematics that can be created by a group of culturally diverse students. Unfortunately, many teacher education programs suffer the same problems as elementary and secondary schools. Programs focus on mathematical content to the exclusion of the nature of mathematics. Professors and graduate teaching assistants are unaware of the importance of culture in mathematics. The curriculum is crowded and must be responsive to state and university requirements. Although these are only a few of the existing problems, we would like to shift our attention to our initial attempts to develop a culture-inclusive mathematics education program.

We began by compiling a bibliography related to multicultural issues in mathematics (Wilson, Mosquera, & Strutchens 1991). We wanted the bibliography to represent a variety of fields and the thinking of a broad international community. We began with articles and books from our personal reading in mathematics, science, mathematics education, education, philosophy, sociology, anthropology, and history. Next, we solicited additional recommendations from international scholars. The bibliography is multicultural, representing work about a variety of cultures, ethnic groups, geographic regions, and ages, as well as a variety of philosophical perspectives. The bibliography was organized into three main sections: General, Mathematics, and Science. Each section was divided into three subsections: Theory, Practice, and Research.

This bibliography became the foundation for a weekly seminar with fifteen participants including both graduate students and faculty. The group represented eight nationalities and was diverse in ethnicity, religion, age, gender, research interests, and content expertise. Each week one or two of the participants lead, preparing an initial presentation and a discussion of an assigned reading from the bibliography. These discussions encompassed both issues and didactical implications. The weekly topics and reading included:

1. What Is Culture?
2. Defining Characteristics of Classifications of Human Diversity
   —Banks, J. A., *Ethnicity, Class, Cognitive, and Motivational Styles: Research and Teaching Implications*.
   —Trent, W., *Race and Ethnicity in the Teacher Education Curriculum*.
3. Underachievement and Underrepresentation of Women and Minorities in Mathematics and Science
   —Sells, L., *Mathematics—A Critical Filter*.
   —Oakes, J., *Opportunities, Achievement, and Choice: Women and Minority Students in Science and Mathematics*.
4. Equity and Equality
   —Secada, W., *Educational Equity Versus Equality of Education: An Alternative Conception*.
   —Grant, C., *Equity, Equality, Teachers, and Classroom Life*.

5. Theories of Mathematics Education and Culture
   —Bishop, A., *Mathematics Education in Its Cultural Context.*
   —Chevellard, Y., *On Mathematics Education and Culture: Critical Afterthoughts.*
   —D'Ambrosio, U., *Ethnomathematics and Its Place in the History and Pedagogy of Mathematics.*
6. Cognitive and Historical Issues
   —Walkerdine, V., *Difference, Cognition and Mathematics Education.*
   —Joseph, G., *Foundations of Eurocentrism in Mathematics.*
   —Hemmings, R., *Mathematics.*
7. Research and Political Perspectives
   —Pinxten, van Dooren, & Harvey, "Applications in the Teaching of Mathematics and the Sciences," In *Anthropology of Space.*
   —Frankenstein, M. & Powell, A., *Empowering Non-traditional College Students: The Dialectics of Society and Mathematics Education.*
8. Studying Cultural Diversity: Contexts and Cases
   —Grant, C., & Sleeter, C., *After The School Bell Rings.*
   —Yates, P., *Figure and Section: Ethnography and Education in the Multicultural State.*
9. Culture and Mathematics Learning
   —Stigler, J. & Barnes, R., *Culture and Mathematics Learning.*

In addition to reading, participating in discussions, and leading a session, each participant read and annotated articles from the bibliography. These discussions were always scholarly and included lively debate, but the strength of the seminar was in the personal sharing and reflection related to the nature of mathematics and mathematics learning. As the participants became more aware of problems and inequities, they expressed a frustration summarized in the question: What can I do now that I am more aware? This is a difficult question, and each person had to formulate his or her own answer. One group is currently working on activities for mathematics classrooms in grades 6-12. These activities highlight the culture-inclusive nature of mathematics. Also, members from the seminar are teaching a variety of courses at both the college and secondary level; and there is some evidence of the influence of the seminar on their assignments, discussions, and perspective towards curriculum.

Although we began with a seminar and an extensive bibliography related to multicultural issues in mathematics education, we are philosophically opposed to the idea that there should be one course dedicated to multicultural issues in mathematics. These ideas cannot be tied up into one neat package. The culture-inclusive nature of mathematics needs to be evident in every mathematics and mathematics education course. To try to deal with cultural ideas in mathematics without a context is artificial and leads to grand, generic guidelines that are hard to bring into practice. It is not effective to claim that different cultures have impact on mathematics unless there is a way to exhibit the claim. Students need to see the cultural influence in the mathematics they are studying, because such insight can strengthen the students' understanding of both the specific content and the general nature of mathematics. The implementation of culture-inclusive mathematics also provides an opportunity to address cultural issues, such as why a particular topic was or was not developed by a specific culture. By looking at a group's approach to a mathematical topic, we can learn more about its culture and view of mathematics.

The following scenarios are offered as examples of how cultural influences can be recognized and affirmed in traditional content.

Fractions in Elementary School. Ancient cultures used fractions, but they were different from the fractions we use today (Burton 1991). About 3000 B.C., the Babylonians, near the Persian Gulf, used a sexagesimal system based on 60 rather than our decimal system based on 10. They required that their fractions all have a denominator of 60 or a power of 60. For example, they would not use a fraction like $^{1}/_{2}$, but would use $^{30}/_{60}$ to represent one half. They would use $^{10}/_{60}$ for $^{1}/_{6}$, $^{20}/_{60}$ for $^{1}/_{3}$ and $^{12}/_{60}$ for $^{1}/_{5}$. The Egyptians, in northern Africa, used unit fractions where the numerator was 1. If they wanted to talk about $^{2}/_{5}$, they would call it $^{1}/_{3} + ^{1}/_{15}$. They would record all of their fractions as unit fractions or the sum of unit fractions. For example, they would use $^{1}/_{3} + ^{1}/_{4}$ for $^{7}/_{12}$, and $^{1}/_{5} + ^{1}/_{10}$ for $^{3}/_{10}$. To apply these concepts, elementary students could represent several fractions using current fractions, Babylonian fractions and ancient Egyptian fractions, and then the teacher could guide the discussion with important questions

such as: What advantages did the Babylonians see in using a denominator of 60? Why do you think the Egyptians liked to use unit fractions? What advantages do current fractions have? What would happen if we only used fractions with denominators of 10 or powers of 10?

Algebra in Secondary School. Based on the historical development of Algebra, teachers can present rhetorical, syncopated, and symbolic stages of algebra. Examples of each kind of algebra, showing the development from orally solved problems to abbreviated words to the current symbols, can be found in most history of mathematics books. Students could be asked to solve problems algebraically using these three approaches. Such an experience could help students develop a better appreciation of our current symbolic algebra.

In a contrasting approach, the teacher could present different methods of teaching algebra that were considered by the United States at the turn of the century. On the one hand, French analytic algebra emphasized a gradual introduction of mathematical ideas by using a number of examples and applications. On the other, British synthetic algebra favored the introduction of definition and justifications, and then working problems. By discussing which approach would be more appropriate for American algebra students, new versions of both approaches and a characteristic American approach emerged. The American approach, developed by Benjamin Pierce, emphasized mathematical definitions and rigor, but avoided philosophical discussions, especially about the nature of negative numbers. Questions for class discussion include: What algebraic approach (rhetorical, syncopated, or symbolic) is most convenient for solving equations? Which of these approaches could be more helpful for pupils studying algebra for the first time? Why did Great Britain and France develop different approaches to algebra?

Number Theory in College. Pythagorean triples (x, y, z) are numbers which satisfy the relationship $x^2 + y^2 = z^2$. It is often taught that Pythagoras, a Greek from Samos, discovered this relationship in a right triangle. Both Pythagoras, who lived in 550 BC, and Diophantus, who lived in Alexandria 800 years later, created formulas to generate these special triples. It was not until 1220 AD that an Italian mathematician,

Fibonacci, proved that all such triples can be generated from formulas based on the work of Pythagoras and Diophantus. Amazingly, these same triples were found in Babylonian tablets dating back to 1900 BC. There is some evidence that the Chinese proved the relationship in a right triangle around 600 BC (Burton 1991). Questions for discussion include: Why is it so difficult to find the origin of a piece of mathematics? Did different cultures invent the same mathematics independently? Why did the Babylonians record these numbers and not show any relationship to a right triangle? Why did it take so long to prove what had been "known" for centuries?

Arithmetic Algorithms in a Methods Class for Elementary Teachers. Learning procedures or algorithms for different arithmetical operations such as long division consume a large portion of elementary mathematics. Often these algorithms are introduced as if they were the only correct way of operating rather than a particular, convenient procedure. Teachers may be unaware that different countries have different ways of recording the same algorithm. For example, students from different countries may write the same division algorithm in different ways (see Figure 1).

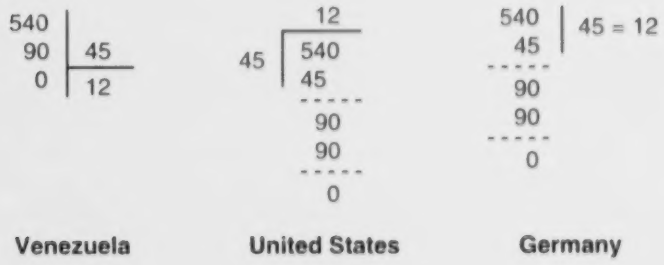

Figure 1

Throughout history, different algorithms have been used to perform the same operations. Consider the ancient Egyptian algorithm using doubling and the present multiplication algorithm for finding the product of 71 and 12.

1	71
2	142
*4	284
*8	568
12	**852**

Ancient Egyptian

```
  71
x 12
----
 142
+710
----
 852
```

Present Day

Figure 2

The ancient Egyptian algorithm used the convenient strategy of doubling (see Figure 2). Knowing that 4 + 8 = 12, 4 x 71 = 284, and 8 x 71 = 568, the student could find 12 x 71 by adding 284 and 568. The common present day algorithm uses place-value knowledge to arrive at the same product.

In class, the students can compare the two algorithms discussing the advantages of each. What would be the value of teaching each way? Then have their class invent their own algorithms for multiplying 71 x 12.

Minority Contributions to Mathematics in a Methods Class for Secondary Teachers. Based on data from the 1988 Task Force on Women, Minorities, and the Handicapped in Science and Technology, African Americans comprise about 12% of the population and 2% of the nation's employed scientists and engineers. They earn 5% of the baccalaureate degrees and 1% of the Ph.D. degrees awarded in the U.S. in science and engineering. Classes can discuss the responsibility of high school mathematics classes in adjusting such inequities. Are African American contributions to the sciences acknowledged? How do Hispanic and Native American statistics compare? What are teacher beliefs and actions that contribute to poor achievement among some students of color or that facilitate high achievement among them?

Videotape Analysis in a Graduate Research Class. In research, we are beginning to recognize the value of videotapes of students working on

mathematical tasks. We can hear the intonations carried in a response which are lost in a typed transcript. Researchers study body language and facial expressions as clues to what a student might be thinking. In addition, researchers can observe the influence of previous and present cultures on the mathematics and behaviors. How does a particular culture influence the rules of discourse between an adult and a student? Does social status or self-confidence influence a student's willingness to try something new? Is deductive reasoning prominent in discourse?

Field Experience. Most mathematics education programs include some kind of experience in schools. We often talk about the school culture, but there is actually an individual culture in each school, and even in each classroom. Urban, suburban, and rural schools also reflect different cultures. If a teacher experiences a variety of situations, then the influence of culture in mathematics will be easier for the teacher to recognize. Solutions to discipline problems may be appropriate in one situation and not in another. Methods for motivating students will vary depending on student goals and opportunities. Effective communication may depend on the teacher's ability to appreciate a different culture.

This collection of examples serves to illustrate how useful it can be to recognize cultural influences in mathematics at all levels and at every stage of teacher preparation, including both mathematics and education courses. A generic class on multicultural issues lacks the opportunity to offer relevant examples in a specific context and tends to provide a foundation that is never developed. Although an introductory seminar on multicultural issues in mathematics could be beneficial, it is necessary to include cultural issues in all mathematics education courses.

Enrollment

College enrollments illustrate the underrepresentation of certain groups in mathematics. If we want to break the cycle of unpreparedness for some students of color, we must offer ways for these students to

prepare themselves. It is irresponsible to simply offer students an opportunity to fail. Our goal is to graduate more students from underrepresented groups with expertise. High standards must be maintained, but teachers and professors have the responsibility to move students *from where they are to a higher level of expertise*. Programs that emphasize enrolling more students in algebra without addressing the needs of those students cannot succeed. Tragically, these well-meaning efforts to increase enrollments may actually weaken the algebra courses and result in a lower level of expertise for all students. While increasing the enrollment of underrepresented groups is a necessary component of improving mathematics classes, it is not sufficient and can be detrimental to all of the students involved.

Some schools have addressed this problem by providing more instruction, additional work, and tutorial sessions, and by promoting study groups. For example, Fullilove and Triesman (1990) offered such support for calculus courses at the college level, and Escalante (Escalante & Dirmann 1990) worked with high school students in calculus. These appear to be effective interventional programs that are able to pull students who have mentally dropped out of mathematics, back into mathematics programs. Our goal should be not to let these students leave.

Research: A Need for the Future

The previous sections have described culture-inclusive mathematics, elaborated on some of the current thinking related to culture and mathematics, and illustrated some implementations of culture-inclusive mathematics. Much of the current work remains experimental because relatively few studies in mathematics education have considered the influence of culture on mathematics or mathematics learning. The social construction of mathematics occurs in schools, commerce, art, and through activities such as counting, locating, measuring, designing, playing, and explaining (Bishop 1988c). All of these environments are culturally organized, illustrating that culture is an integral part of mathematics education and should be addressed in both theoretical frameworks and research design. Research

needs to explore how culture influences mathematics teaching and mathematics learning.

Mathematics education research is predominately influenced by frameworks and models from psychology. While these models have offered a useful structure for inquiry, they have created considerable limitations. For example, the Piagetian framework is based on one particular culture (European) and has been used as a measuring stick for other cultures. In the psychological tradition, much of the mathematics education research is based on controlled or clinical situations rather than dynamic, social situations, such as classrooms or the work place. Sample populations used in research often do not reflect the diversity of the United States population. There are few cross-cultural studies and even fewer studies of specific cultures. In the past, mathematics education researchers have not paid enough attention to research in social psychology, sociology, and anthropology. Of equal concern is the fact that studies in those areas related to mathematics and education, have not been informed by the work done in mathematics education. We need to continue to draw from psychological research, but we need to strengthen our theoretical frameworks and methodologies by turning to additional disciplines.

There are several encouraging developments that may lead mathematics education research in the direction proposed in this paper. Valsiner (1989), in his works on developmental psychology, makes the point that culture should be regarded as an inseparable component of a child's development. Others use a situated cognition perspective, which assesses the situation in which the cognitive activity takes place and then studies how the situation influences the cognition. Scribner (1985) has studied how the active participant learned and organized mathematical knowledge in a way that fit conditions in the work place. Saxe (1991) has studied Brazilian children selling candy in order to understand how the culture of candy selling contributed to the seller's organization of mathematical knowledge. Lave (1988) has looked at mathematics as it was used and constructed in grocery shopping and weight-watching activities. Cole and Scribner (1974) have studied multiple aspects of cognition (e.g. problem-solving) and their connections to culture, and Carraher, Carraher, and Schliemann (1985) have looked at how school and street mathematics were used by children in

a specific context. We have already mentioned another group of researchers whose work in the philosophy and sociology of mathematics (Bloor 1976; Restivo 1983; Struik 1942) could have a strong impact on the ways in which we conceive of mathematics and mathematics education. This research comes from outside the field of mathematics education and within perspectives that are frequently overlooked by mathematics educators.

Within mathematics education itself, a few researchers are studying mathematics as a socio-cultural product and process, and mathematics education as a social process. Bishop (1988b) has proposed that all cultural groups have the capacity to create mathematics and that they do engage in mathematical activity even if they would not explain it as mathematical. Cobb (1989) has argued that mathematics learning and teaching must be studied from three perspectives: experiential, cognitive, and anthropological. Mellin-Olsen (1987) has worked on a general theory of the politics of mathematics based on a synthesis of diverse perspectives such as anthropology, psychology, and activity theory. Walkerdine (1990) has elaborated an approach for research on the psychology of mathematics education in which cultural, gender, and racial differences are taken into account. Other mathematics educators are working to change the curriculum and teaching methods so that mathematics is more relevant and accessible to more cultures within the United States (Anderson 1990; Frankenstein 1990; Fullilove & Treisman 1990).

As we pointed out in the second section of this paper, the adoption of a culture-inclusive mathematics education perspective requires serious questioning of the ways in which one conceives of mathematics, its teaching, and its learning. This means that research on teachers' conceptualizations of mathematics and culture is of major importance. Researchers studying teachers, beliefs, conceptualizations, and theories have often ignored issues related to people of color and diversity in the mathematics classroom (Secada 1988). We know of two studies that have focused on teachers' beliefs about teaching pupils from diverse populations (McDiarmid 1990; McDiarmid & Price 1990). Both studies reported that participation in a workshop about multicultural education had little effect on teachers' and student teachers' stereotypes and views of teaching minority

pupils. These findings raise some questions about the effectiveness of workshops in changing teachers' views on multicultural education. There is, however, reason for hope. Wood, Cobb, and Yackel (1991), in a study on teachers' learning in the setting of the classroom, report changes in a teacher's beliefs about the nature of mathematics, and the learning and teaching of mathematics during her participation in a research project that was carried out in her classroom. Although Wood *et al.* did not regard cultural issues in the classroom, their study offers important insights for developing culture-inclusive mathematics education. We could conclude from these studies that more systematic work with teachers and student teachers is needed if one wants to challenge stereotypes and change current views about pupils from diverse cultures and the ways they learn mathematics.

Culture-inclusive mathematics education should not be associated with a specific research methodology or research paradigm. Both quantitative and qualitative methods can be used to investigate from a culture-inclusive perspective. The works described above are representative of activities, from both inside and outside mathematics education, which offer promising directions for investigation as the mathematics education community tries to define culture-inclusive mathematics. Of course, more research is necessary. The emerging work is actually posing more questions than it is providing answers, but these questions can lead us in a direction that will broaden our concept of what constitutes mathematical knowledge. The new multidisciplinary approaches should provide insight into the challenges of teaching school mathematics and facilitating the learning of all students.

A Challenge

We would like to challenge all mathematics educators and researchers to consider the concept of culture-inclusive mathematics. We believe that culture-inclusive mathematics will enhance the way people think about mathematics. Teachers will see their mathematics classrooms differently, curriculum designers will see curricula differently, researchers will formulate their questions differently, and learners will own their mathematics.

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4

A Comprehensive Multicultural Teacher Education Program: An Idea Whose Time Has Come

H. Prentice Baptiste, Jr.
Carol Archer

Multiculturalism "should help students develop a better understanding of their own backgrounds and of other groups that compose our society. Through this process the program should help students to respect and appreciate cultural diversity, overcome ethnocentric and prejudicial attitudes, and understand the socio-historical, economic, and psychological factors that have produced the contemporary conditions of ethnic polarization, inequality, and alienation. It should also foster their ability to critically analyze and make intelligent decisions about real-life problems and issues through a process of democratic, dialogical inquiry. Finally, it should help them conceptualize and aspire toward a vision of a better society and acquire the necessary knowledge, understanding, and skills to enable them to move society toward greater equality and freedom, the eradication of degrading poverty and dehumanizing dependency, and the development of meaningful identity for all people" (Suzuki 1979, pp. 47-48).

These eloquent words written by Robert Suzuki in 1979 outline a contemporary vision of the ideals articulated by the founders of the United States. Those founders, by proposing a society different from any that had existed in human history up to 1776, have given those of us who live in the United States the possibility of building a society in which all people are "created equal with certain inalienable rights." And it is that society which Bob Suzuki has described. This chapter is concerned with the preparation of teachers for such a society—teachers who can guide its children to become citizens. In order to educate the children, the teachers themselves must be citizens with dignity, insight, compassion, and knowledge about this culturally

diverse society in which we live. The challenge facing teacher education programs is to prepare teachers to bring forth the best in children who are diverse in ability, in class background, and in language and cultural backgrounds. Specifically, we must prepare teachers to be multicultural beings—fully cognizant of the multicultural society in which they reside—so that they may ensure that the children maximize the opportunity of living in a very diverse country.

Equity in Education

For over three decades, some educators have recognized the importance of and have grappled with the difficulty of teaching a diverse population of students. The rest of society paid much less attention to the lessons that were being learned within this segment of the educational community. In fact, a great fatalism and hopelessness has permeated much of society (educators and others) as we have confronted the reality of a society that oppresses most of its people—mocking the words of the Declaration of Independence and holding Suzuki's vision at arm's length. Yet, it is in our schools that the conceptualization can become a reality. And it is with the certainty of that belief that we present our proposal for preparing teachers to learn about equality so that they may model equity in the classroom. To explore this idea, this chapter will focus on two separate disciplines that have developed in the last 50 years—multicultural education and cross-cultural communication—and suggest a way that they might be combined to provide a substantial multicultural base for teacher candidates.

Overview of Multiculturalism and Cross-Cultural Communication

Before offering a proposal for a multicultural teacher preparation program, let us look to the past as we trace the history of both multiculturalism and of cross-cultural communication. Multicultural education developed from the field of multiculturalism, which focused on domestic cultural differences such as ethnicity, gender, age, and

physical ability. Multicultural education is concerned with how these differences inhibit an individual's educational process and his or her subsequent role in the society at large. While multiculturalism was developing in education, in the business world cross-cultural communication was developing training programs which prepared employees to work in other countries. Additionally employees within the same company were prepared to work at a higher level of efficiency and the government prepared its employees to implement various types of governmental programs in other cultures. Therefore, although the business community and the educational community have both been interested in and have developed ways of dealing with cultural differences, they approached the subject in different ways. Some of the reasons for these differences can be better understood by looking at the historical development of each of the disciplines.

History of Multiculturalism

Let us first take a more in-depth view of the emergence of multiculturalism. As described by H. Prentice Baptiste, Jr. (1991), in his work, *Developing the Multicultural Process in Classroom Instruction: Competencies for Teachers*, multiculturalism is a political concept that emerged in the 1960s—as the direct result of a political process. It is a domestic concept indigenous to the United States and evolving out of the 1960s recognition of cultural pluralism as a viable alternative philosophical goal governing the interrelationship of the various cultural/ethnic groups within our country. And it is this concept from which multiculturalism emerges with its implicit belief in the development of an ideal society, such as the one described previously by Suzuki. However, it is important to understand that multiculturalism has not always been the accepted view of American society, and we need to be aware of those alternative beliefs about the nature of American society. Before the concept of multiculturalism evolved, two other concepts about American society were prevalent. The first of these was Americanism, which emerged in the 1700s and 1800s and which posited the idea that Anglo-Saxon culture was superior to others and that immigrants from other parts of the world should be "molded" to fit as best they could into an Anglo-Saxon profile. A second concept

about American society arose in the early 1900s with the idea of the melting pot in which it was thought that all people in the United States would "melt together" and form a new "hybrid." It assumed that all people would have an equal chance to contribute to this hybrid. In reality both concepts were discrimination—the first overtly and the second covertly. Multiculturalism has to be understood as standing in juxtaposition to those earlier systems of belief.

In the early part of the twentieth century, a form of cultural pluralism was proposed by Horace Kallen who described a society that honored all cultural differences while adhering to a common American belief system. Unfortunately, he "failed to consider the intolerant attitude of the Americanists and the willingness of the immigrant groups to forsake their cultural and ethnic heritage.... his theory ignored, to its detriment, the political nature of our society" (Baptiste 1991, p. 17). It was not until the 1960s that cultural pluralism was rediscovered as a result of the convergence of multiple societal influences—the Supreme Court Decision of *Brown v. Topeka*, self-determination of oppressed groups, the acknowledgement of the "unmeltable" ethnics (Novak 1973), and the disillusionment of large numbers of Americans with Americanism and its denigrating, ethnocentric process. Other contributing factors include mass media's presentation of Civil Rights marches, violence against peaceful demonstrations for equal rights, as well as fictional presentations such as *Roots*, *Holocaust*, and *Bury My Heart at Wounded Knee*. At this time, people began to understand that the "melting pot" was a fantasy and that, in fact, there were some groups that were "unmeltable" (that is, Poles, Italians, Greeks, Slavs) and that some other groups were never allowed to melt (such as African Americans and Mexican Americans). The form of pluralism that emerged in the 1960s and out of which multiculturalism comes is a cultural pluralism in which individuals as Baptiste (1991) says, "retain their primary cultural heritage and experience while acquiring the skills and knowledge of another or other cultures" (p. 19).

There has been a substantial development of a theoretical base for the field. Any list would include, but not necessarily be limited to, such works as *Multicultural Education Through Competency-Based Teacher Education*, edited by William Hunter (1974), *Pluralism and the American Teacher: Issues and Case Studies*, Frank Klassen and Donna Gollnick,

editors (1977), *Teaching Strategies for Ethnic Studies*, James Banks (1987), *Comprehensive Multicultural Education: Theory and Practice* by Christine Bennett (1986), *Multicultural Education in a Pluralistic Society* by Donna Gollnick and Phillip C. Chinn (1985), and *Turning on Learning: Five Approaches for Multicultural Teaching Plans for Race, Class, Gender and Disability* by Carl Grant and Christine Sleeter (1989). And it is this pluralism, with its extensive theoretical base, that lends itself to the methodologies developed in cross-cultural communication.

History of Cross-Cultural Communication

Similarly, let us trace the historical development of cross-cultural communication. Like multicultural education, it is a product of its time in history. After World War II, it became obvious that there was a need to prepare the large number of Americans who swarmed overseas to work and study as well as the increasing numbers of international students who were entering the United States to study. An interest in cross-cultural communication as a discipline was really boosted in the early 1960s, as groups of young Americans responded to President Kennedy's call to go to developing countries around the world and share their technical skills with the people in those nations through the Peace Corps. These young men and women were skilled in their technical specialties and were given academic courses in the history, culture, and language of the countries to which they were being sent. Two years later, many who returned were disillusioned and became involved in the fledging field of cross-cultural communication. Their interest was personal as they realized—sometimes with anger and frustration—that they had not been adequately prepared to fulfill their vision. They had, in fact, frequently caused more problems in the countries where they had lived. They began to ask the question, "How do we learn to communicate cross culturally, and how do we pass that skill on to others?" As the field of cross-cultural communication has grown, it has borrowed theory from anthropology, sociology, communication, linguistics, human resource training and combined it in a discipline that has been applied primarily in business training and in preparation for international students who are studying in the United States. The works of Edward T. Hall, *Silent Language* (1959) and *Beyond*

Culture (1976), Edward Stewart's *American Cultural Patterns: A Cross-Cultural Perspective* (1971), and Larry A. Samovar and Richard E. Porter's anthology, *Intercultural Communication: A Reader* (1976), as well as the anthology, *An Introduction to Intercultural Communication* (1975) by John Condon and Fathi Yousef formed the original theoretical basis for the field. As it has grown, it has spread out of the United States and around the world and is one of the areas of study that, in its membership, is truly international.

Current Societal Influences on Cultural Diversity

As this brief history of the two branches of study indicates, neither cross-cultural communication nor multiculturalism developed in a vacuum—rather they emerged as a result of political and economic forces in this country. Until this point in history, the rest of society paid little attention to multicultural communication or worse, denied its importance. At the same time cross-cultural communication was virtually unknown except by those few who dealt with other cultures internationally. Yet, today, perhaps the moment has come for a new level of awareness and acceptance of these two disciplines by the general public. One indication is the new interest on the part of business to the idea of diversity in the work force. This interest has been largely the result of a study commissioned by the U. S. Department of Labor in the 1980s and published in June 1987 in the form of a small booklet entitled *Workforce 2000: Work and Workers for the 21st Century*. Although it is small, this study has reverberated throughout the business community (Johnston & Packer 1987), showing that the work force in the twenty-first century will be more female and less White than it is today. It is projected that the work force will be comprised of 15% White males, as opposed to 47% today; 42% White females, as opposed to 36%; 7% native people of color, as opposed to 5%; 13% native females of color, as opposed to 5%; 13% immigrant males, as opposed to 4%; and 9% immigrant females, as opposed to 3%. For the first time, business and education are confronted with a common domestic concern: a unique opportunity for an authentic, comprehensive multicultural education for all citizens of the United States.

Multicultural Education

With the convergence of these two areas—business and education—it behooves us to look closely at both the opportunities and the work needed to take full advantage of these opportunities. After having traced the history of multicultural education and cross-cultural communication, let us now examine the heritage of the two disciplines—the models and techniques they have given us that would be useful in preparing a culturally aware and culturally sensitive teacher.

Approaches to Multicultural Education

Turning first to multicultural education, let us examine various approaches toward diversity that have evolved over the last several decades. According to Sleeter and Grant (1987), there are five different approaches to multicultural education: (1) teaching the culturally different, (2) human relations, (3) single group studies, (4) multicultural education, and (5) multicultural and social reconstructionist. Sleeter and Grant describe and analyze each approach. The first approach, teaching the culturally different, focuses mainly on helping students of color to maintain a positive identity and to develop competence in the dominant culture. The culturally-different approach emphasizes relationships between groups while neglecting to mention unequal distribution of goods and power between groups. It also limits itself to ethnicity rather than including other forms of diversity. In addition, it ignores any need on the part of Whites to learn about racism and ethnocentrism. The culturally-different approach is strong in its commitment to children of color and weak in its implementation. The second approach, a human-relations approach, emphasizes improving communication between various groups of people, but it has no real emphasis on cross-cultural differences. However, it does give very specific guidelines for helping students understand culturally different classmates through use of materials, such as notebooks and illustrations. The human-relations approach is like the first approach in that it fails to address negative societal influences. A third approach, the single group studies, focuses on the experience and culture of a specific group such as African Americans

or Mexican Americans. Sleeter and Grant (1987) found that this approach shared some weaknesses with the human-relations approach in that it had no clear cut goals. Banks (1973), however, states that the goal of this approach is to "help students develop the ability to make reflective decisions so that they can resolve personal problems, and through social action, influence public policy and develop a sense of political efficacy" (p. 116). Indeed, only Banks has developed anything resembling a conceptual framework for this approach. This approach tends to disregard multiple forms of diversity, concentrating on ethnicity or gender only. The fourth approach, that of multicultural education, has very well defined goals, which are summarized by Gollnick (1980, p. 9) as "promoting strength and value of cultural diversity.... Human rights and respect for cultural diversity.... Alternative life choices for people.... Social justice and equal opportunity for all people.... [And] Equity distribution of power among members of all ethnic groups." It can be seen from these goals that this approach includes studying power relationships and economic and social injustices. While the multicultural education approach is the most popular, it is less frequently implemented than the others. Sleeter and Grant (1987) found that, "There is little carry over from the models to the teaching guides... advocates... have needed to concentrate so much on clarifying goals and providing a rationale that they have considered implementation less systematically (p. 433-34)." The model offered later in this chapter addresses itself to that need. Multicultural education can include not only ethnic and cultural differences, but also differences in age, gender, class, and physical ability. However, it places much less emphasis on social stratification. It is left to the fifth approach to address this issue. The fifth approach, the multicultural and social reconstructionist approach, adopts the goals of multicultural education and uses them as a point from which to stress empowering students to change social inequality.

The approaches outlined above form the goals of what should be studied in multicultural education (Grant & Secada 1985). Multicultural education includes differentiation by race, class, gender, and language as areas to be studied as well as five concepts including: (1) teaching the different child, (2) human relations, (3) single group studies, (4) multicultural approaches, and (5) education that is

multicultural and social reconstructionist. The focus of the five aspects of the Grant-Sleeter typology includes making the curriculum relevant to the students' backgrounds and adapting it to their learning styles and skill levels. The Grant-Sleeter typology attempts to foster positive relationships between members of different groups and between males and females, focuses on the culture and history (both negative and positive aspects) of particular groups, and makes teachers aware of how their own assumptions and teaching behaviors affect the students and continue oppressive patterns in the classroom.

Having examined the dominant approaches to multicultural education, let us now look in detail at the work of two individuals, Geneva Gay, who articulates specific skills needed by teachers to be effective in multicultural classrooms, and H. Prentice Baptiste, Jr., who has developed a typology of multiculturalism that can be used as a guide for determining the degree of internalization of multiculturalism.

Skills Needed by Teachers in Multicultural Classes

Gay (1990) posits three skills that multicultural teachers should have:

> ...*(a)* conceptualizing equity as the comparability or equivalence of learning opportunities for diverse learners instead of as the same treatment for everyone, *(b)* becoming consciously aware of routine teaching behaviors that militate against educational equity, and *(c)* learning how to make regular instructional procedures more accommodating to culturally different students. (p.225)

She points out that teachers have been trained to accept as "normal" and right a Eurocentric point of view of classroom behavior and interaction which is biased against the cultural experiences and behaviors of students of color and students from low socioeconomic groups. These biases are deep-seated and, even when teachers try to prevent their ethnic and social biases from surfacing, they unconsciously discriminate against students who are different. She suggests that teachers first become aware that all students do not learn in the same way and that cultures influence the way students learn. For example, White Americans learn well in large groups that are passive

with the teacher in control, while African Americans are more kinesthetic and perform better in a classroom which is highly interactive and varied. She suggested that teacher preparation programs should offer courses in cultural differences and help teacher candidates to prepare and present lessons in the various ways that students learn. Specifically, teacher preparation programs should offer courses in cross-cultural differences and courses in analyzing common educational practices which help some students and inhibit others. The preparation and presentation of lessons will provide practice in applying these principles.

Typology of Multiculturalism

Having outlined the specific skills which Gay recommends that teachers develop, we will now examine a typology for evaluating the level of multiculturalism in a teacher, school classroom, or any educational entity. Baptiste (1989-1990) has developed such a typology. His typology of multiculturalism is based on the idea that educational entities manifest three distinct levels of multiculturalism and that each level differs qualitatively (regarding emphasis on product, process, and philosophy) and quantitatively (amount of product, process, and philosophy). The typology is concerned primarily with the qualitative aspect (although the quantitative is included) because it is from a qualitative perspective that multiculturalism is internalized. While Baptiste applies the typology to any educational entity, for the purposes of this chapter, the authors shall focus on the application of the typology to teacher educational programs. Accordingly, a breakdown of each of the levels follows (see Figure 1).

Level One is product oriented and represents an additive approach to multiculturalizing a program with a single focus on ethnic celebrations, cultural holidays, or workshops on topics of special interest about ethnic groups. This level lacks any contextual reference. A teacher preparation program might have unrelated workshops or courses on a specific cultural or ethnic group. Any such courses are added on to a curriculum and may be underfunded, intended for specific student populations, and lacking institutionalization. Usually,

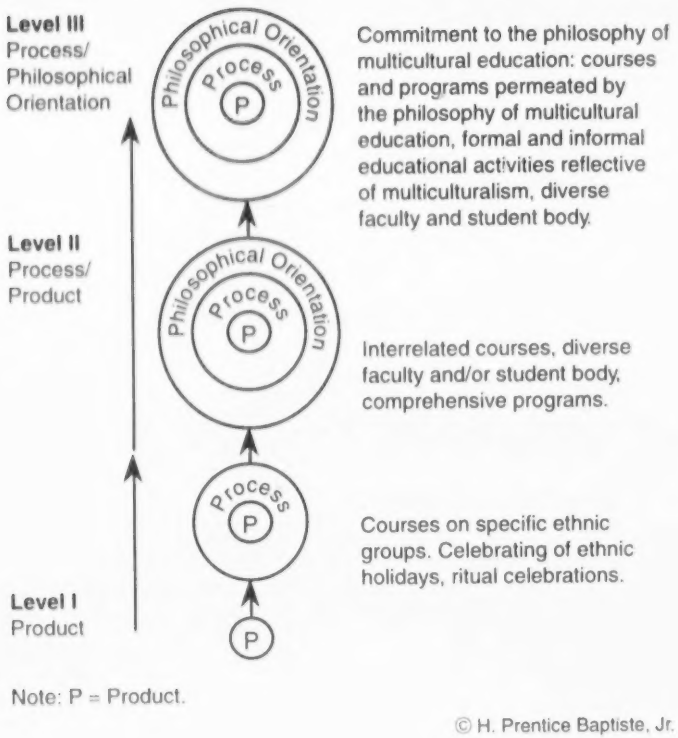

Figure 1. Typology of Multiculturalism

this level of multiculturalization has been brought about by external pressures. Furthermore, this level usually has a faulty theoretical base which is exemplified in the haphazard development and arrangement of its culturally-related activities and experiences.

Level Two manifests both process and product. While it still has workshops and courses on specific populations, they are more integrated into the curriculum, and the curriculum, as a whole, has a broadening conceptual framework for incorporating multiculturalism into the school's program. At this level, there is a theoretical context

that serves to integrate multicultural components and information into the core curriculum. The most salient feature of this level is the restructuring of the curriculum to reflect in a positive and equitable manner the diversity of our society.

The final and third level consists of both process and a philosophical orientation and includes the curriculum innovations from Level Two. However the real difference is in the commitment on the part of the institution to multiculturalism that manifests itself, not only in products and/or processes, but in actively searching for ways to foster positive multicultural experiences. Multicultural education is no longer theory, but reality. Diversity in teacher candidates and faculty is sought and encouraged. A teacher education program at Level Three is capable of generating courses and decisions that are consistent with multicultural goals.

Research conducted at 150 undergraduate teacher education programs revealed that 84% scored at the low end of Level One; 51% of the responding institutions offered no multicultural courses; while 29% offered no multicultural workshops, seminars or multicultural courses. Eleven percent of the responding institutions were at Level Two, while only 10% were at the low end of Level Three (Baptiste 1989-1990). This research reinforces the conclusion of Sleeter and Grant (1987) that implementation is the weakest aspect of multicultural education. This chapter addresses that implementation. We have seen that multicultural education has given us goals for skills that teachers should possess as well as tools for an ongoing evaluation of both a teacher preparation program and of an individual teacher's own progress in internalizing multiculturalization. It is in the area of implementation that cross-cultural communication can be of use. Let us examine some of the methodologies and concepts that can be adapted from cross-cultural communication for teacher education.

Cross-Cultural Communication

The fundamental concept underlying the development of the methodologies, programs, and theory in cross-cultural communication is that the values, behaviors, beliefs, and assumptions of one's own culture must be brought to a conscious awareness before effective interaction

with persons from other cultures is possible. Another basic concept is that the examination of cultural differences is valid on several accounts. As Barna and Jain (1978) wrote over a decade ago, cultural differences are useful for purposes of contrast so as to bring one's own cultural background into awareness. Secondly, it is assumed that cultural differences affect various aspects of the communication process and therefore need to be understood fully in order to communicate more effectively. The assumptions lead Stewart to state, "The overall goal of cross cultural training is to provide a framework within which people can develop skills and acquire the knowledge that increases their ability to function effectively in a bi- or multicultural environment and to derive satisfaction from the intercultural experience" (cited in Pusch 1979, p.95). These assumptions have led to an emphasis on the development of training programs that could efficiently and quickly give people new communication skills so that they can be more effective in their jobs overseas or, in the case of international students, are able to take full advantage of any educational experience. As a result, we find extensive development of methodology over the last several decades.

Cross-Cultural Methods

These methodologies include the simulation method, role plays, case studies/critical incidents, and Contrast American. The simulation method involves some type of game in which individuals play the role of either mock cultures or of cultures other than their own and act out certain scenarios. The intent of the simulation is for the participants to "experience" going to another culture, ethnocentrism, and cultural isolation in a controlled environment. The facilitator then guides the debriefing so that participants can acknowledge their feelings and reactions and notice the similarity to actual cross-cultural experiences. While there are a number of simulations, Bafa Bafa, designed by Shirts (1973), is one of the most well-known. Hoopes and Ventura (1979) were among the early developers of Contrast American methods in which lists of American values/behaviors are examined and then contrasted with the opposite values/behaviors, thereby enabling the participants to evaluate their own cultural and/or individual values

and behaviors as being on a continuum between the two. Brislin *et al.*'s (1986) cultural assimilator takes a critical incident—an occurrence between individuals from differing cultures in which they have different behaviors—and expands on it, culminating with four possible explanations for the different behavior. The participant has to choose one of the explanations. Each of the four choices is then explained as to whether it is more or less probable. Role playing is normally used so that participants can try out the behavior of another culture to try a new personal behavior that is more appropriate for dealing with another culture. Case studies are similar in that they are a written example of a culture conflict or problem which the participants have to try to resolve. All of these methods emphasize experiential learning because research shows such learning to be most effective in enabling students to acquire useful knowledge of other cultures.

Cross-Cultural Programs

There have been three basic kinds of programs for cross-culture communication. Two have been almost exclusively in the field of business— the predeparture orientation and the re-entry programs. Predeparture orientation programs have been designed for individuals (mostly American) going to live in other countries, giving the Americans information about the new culture as well as the process of communication. Re-entry programs have been designed for individuals returning from overseas assignments to assist them in re-adapting to their native culture as quickly as possible. The third program, Intercultural Workshops (ICW), has more relevance for this chapter. An ICW can last from one week to one semester and has three basic sequential parts. The first part introduces the concepts of culture and attendant aspects such as ethnocentrism, stereotyping, and communication. The second part emphasizes self-awareness and values clarification, while the third section introduces culture specific information (see Figure 2). The progression of the ICW is from low risk activities to high risk, from highly structured to less structured. The ICW has been used extensively in business training in corporations that have employees of differing cultural backgrounds (especially between American and Saudi employees during the 1970s) and has

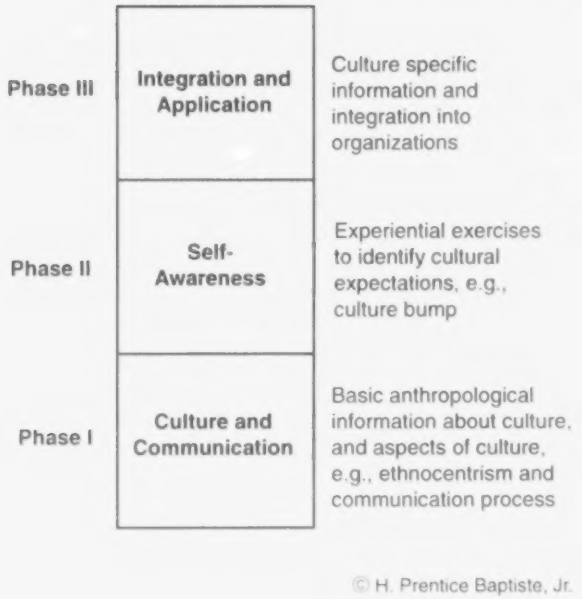
Phase III
Integration and Application
Culture specific information and integration into organizations
Phase II
Self-Awareness
Experiential exercises to identify cultural expectations, e.g., culture bump
Phase I
Culture and Communication
Basic anthropological information about culture, and aspects of culture, e.g., ethnocentrism and communication process
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Figure 2. Intercultural Communication Workshop Model

also been used in preparing international students for their sojourn in the United States. It was in this latter capacity that the *culture bump* was developed.

Culture Bumps

The culture bump is a concept that incorporates a number of the methods outlined above. We can understand better the origin of the culture bump if we look at the nature of stereotyping according to Brislin (1981). While he outlines four basic functions or reasons for people developing prejudice and stereotypes, it is only the knowledge function that is relevant to the proposal in this chapter. Brislin says that the knowledge function explains one reason for the development of stereotypes and prejudices. According to this concept, stereotypes

and prejudices allow people to explain the world around them to themselves. He further states that this category is derived more from common sense than the scholarly literature and recommends that more attention be given to this common, but heretofore neglected, type of everyday prejudice. The systematic examination of culture bumps is an attempt to do so.

According to Archer (1990), a culture bump refers to those incidents in which an individual has expectations of a particular behavior from others in a particular situation and receives different behavior from other individuals who are culturally different. Simply put, it is a cultural difference or a critical incident. When people have culture bumps, they experience a break in the feeling of affiliation with the other individual. The normal reaction is to try and reconnect, usually by trying to understand *them*. The inquiry stems from a *why* basis, e.g.: Why do they...? However, if we analyze the question: Why do they...? we find that embedded in it is another question: Why do they not do these things the way we do them? or, more succinctly: Why are they different from us? Unfortunately, any answer that is given will now reinforce the sense of separation that prompted the question in the first place. With the best of intentions, the person now has perhaps gained information about *them*, but has actually lost the relationship with *them*. This strategy reinforces cultural differences and thwarts attempts to find universal similarities. The culture bump methodology allows the individual to intervene at the original incident and analyze it in a different way that leads to a different question: How do *they* express...? and embedded in this question is the more fundamental question of How do *they* do what we do? and How are we the same? This inquiry guides the individual to an affective understanding of the concept that we are fundamentally the same yet different culturally. By experiencing that our differences are cultural rather than personal, the individuals feel that they are two human beings sitting side by side looking *out at* their cultural differences, rather than two individuals sitting across from one another looking *at* their differences.

Some examples of culture bumps include a Puerto Rican child lowering his eyes when being scolded, a Vietnamese student offering to use his influence to help his professor at City Hall, a Mexican American teacher standing beside the desk of a White student and touching him on the shoulder, a White teacher using her first name in a class that includes Indochinese students, an African American student looking

at the desk while her teacher speaks to her, American-born teachers putting students from Cuba in small discussion groups, or an African American student coming into the classroom after the class has begun and greeting the teacher as she does so. The specific steps in analyzing any culture bump are as follows:

1. Pinpoint the culture bump.
2. Define the universal situation.
3. List the behavior of the other individual.
4. List your own behavior.
5. List your feelings.
6. List the behavior you expect from people of your own group in that particular situation.
7. What is the quality the particular behavior represents for you?
8. How do people in the other culture express that particular quality?

Upon completion of the steps, the individual with the bump discovers that he does not know what he thought he knew about the other individual. It reveals to him his ignorance and places him in a position to eliminate the ignorance so now he can find the answer to the question that he did not know he had. The process emphasizes the importance of observing behavior in objective language without judgment and the importance of acknowledging one's own feelings—negative as well as positive. Then by analyzing one's own expectations, the individual discovers his own cultural beingness. While validating one's own culture, the process simultaneously legitimatizes the other ways of reacting in a universal situation existing among human beings everywhere. The process provides a language with which to talk about differences without being personal or judgmental of others or of self. For example, to say, "I had a negative (or positive or neutral) culture bump," is accurate and concise. Furthermore, the responsibility for the incident now rests with the appropriate person.

Using Cross-Cultural Communication in Multicultural Education

As can be seen in the overview presented above, we have two similar disciplines developing side by side, but with some critical distinctions. Those distinctions have at times separated them in the past, but may now become their strengths as the two disciplines begin to work

toward a common goal. The logical place for their convergence is at the point of inception—in the preparation of the teacher for a multicultural educational experience. It can be seen that both multicultural education and cross-cultural communication have strengths and weaknesses. Multicultural education has defined system relations, such as power and political influences. It has also defined exactly what a multicultural educational system is and how it should function in addition to developing historical and cultural definitions of various ethnic groups in the United States. It has been less successful in its ability to implement its ideas. Cross-cultural communication has focused on methodology and implementation, yet has not dealt with systemic relationships and historical injustices and oppression of individuals or of groups. Neither group has emphasized commonalities between groups although such a resolution is the implicit goal of both.

After having examined the two disciplines, let us now look at the possibility of blending the two together. This potential was acknowledged by Stewart in a 1973 speech when he stated:

> Cross-cultural training is an affirming experience and this affirmation works to reinforce the role and position of minority groups in a pluralistic society. It functions to reduce tensions and build bridges among people of different cultural backgrounds. It also places heavy stress on the learning potential available in intercultural encounters, ways of taking advantage of those opportunities and the acceptance of cultural diversity as a human resource rather than merely as an impediment to communication.

This is not a new idea, as multicultural education has always used some methodology from cross-cultural communication, but what has been missing is a comprehensive model for the integration of the two disciplines. We will now propose an integration of cross-cultural communication and the various approaches to multicultural education to create the evolvement of a teacher preparation program from Level One of Baptiste's typology to Level Three, focusing on the requirements for an optimum progression through the levels. Throughout the progression, the skills defined by Gay will be acquired until, at the third level, the program reflects the reality of Suzuki's vision with which this chapter began. Specifically, the teacher candidates should receive a basic education in three areas:

Factual information - about various cultures, including their own. Americans, for example, do not study American culture, except tangentially in sociology class. Neither do we study, except in special cases, such as multicultural education classes, Arab American, Hispanic American, or African American cultures.

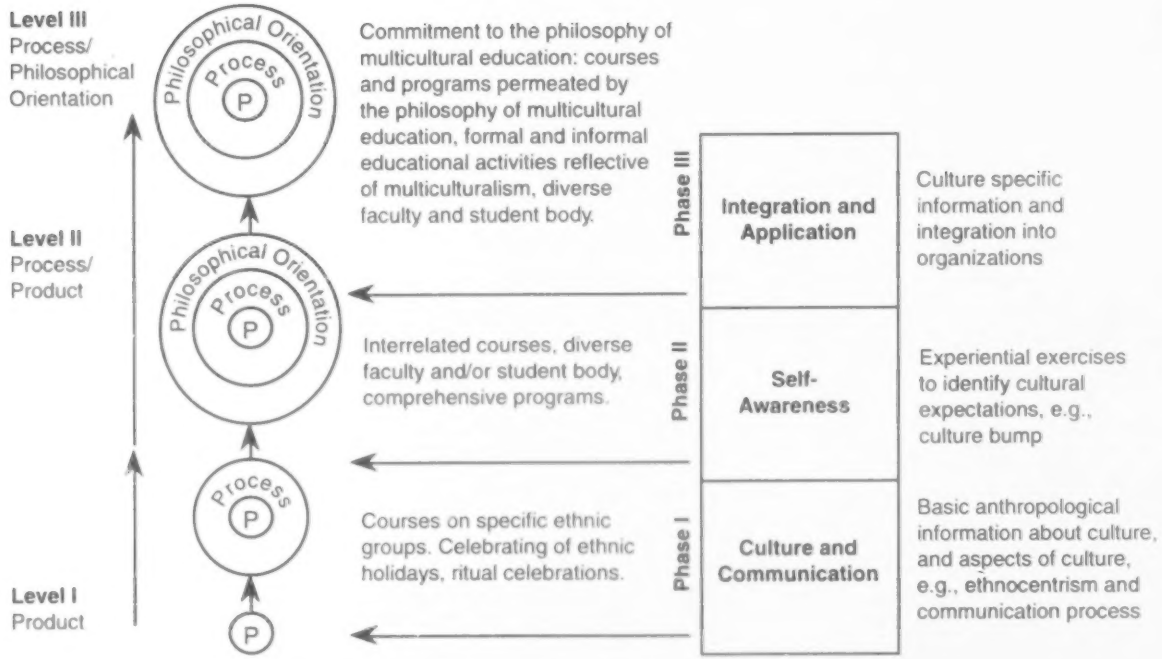
Experiences - actual, field based experiences with people from one's own and other cultures. Teacher candidates should have a structured, multicultural experience in which they are mentored by one or more experienced teachers. This multicultural internship differs from practice teaching which focuses on other aspects of the teaching process. This is an internship in which teacher candidates are specifically dealing with two or more cultures.

Meta-experience - This allows the students to acknowledge, analyze, seek feedback and other interpretations for their actual experience while with other cultures. This experiential learning is critical for an integration of the other two types of learning. In fact, without this type of learning, the other two can actually reinforce stereotypes of people from other cultures.

One way to visualize the sequencing of the progression is to superimpose an Intercultural Communication Workshop (ICW) on the Typology of Multiculturalization in a horizontal fashion. Thus, we can see that at Level One, there is an emphasis on learning about culture, acknowledging differences in culture, and acquiring the skill of effectively communicating cross culturally. At Level Two, there is an emphasis on self-awareness; and at Level Three, the curriculum emphasizes integration of the first two levels with application. Now let us look in more detail at each level of the typology (See Figure 3).

Level One

Starting with the definition of Level One, we encounter a teacher preparation program that is product oriented and represents an additive approach with a single focus on ethnic celebrations and lacking any contextual reference. The question then becomes, how can cross-cultural sequencing and methodology be applied to move this program closer to a Level Two? Since, the minimal level has been achieved through external pressure, the cross-cultural truism of begin-


Level III
Process/
Philosophical
Orientation
Level II
Process/
Product
Level I
Product
Philosophical Orientation
Process
P
Commitment to the philosophy of multicultural education: courses and programs permeated by the philosophy of multicultural education, formal and informal educational activities reflective of multiculturalism, diverse faculty and student body.
Interrelated courses, diverse faculty and/or student body, comprehensive programs.
Courses on specific ethnic groups. Celebrating of ethnic holidays, ritual celebrations.
Phase III
Phase II
Phase I
Integration and Application
Self-Awareness
Culture and Communication
Culture specific information and integration into organizations
Experiential exercises to identify cultural expectations, e.g., culture bump
Basic anthropological information about culture, and aspects of culture, e.g., ethnocentrism and communication process

Note: P = Product. There is not a complete overlap of each model.

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Figure 3. Comprehensive Multicultural Teacher Education Preparation Program (Merging of Multiculturism and Intercultural Communication Models)

ning with low risk and gradually moving to higher risk activities would be well heeded at this point. The two approaches to multicultural education, outlined by Sleeter and Grant (1987) and referred to earlier in this chapter, would be appropriate at this level. In addition, at this level several cross-cultural methodologies would be useful in moving the educational program toward Level Two. Cultural assimilators and case studies are both very effective at this level. They are low-risk yet begin the process of having the teacher candidate start accepting cultural differences. The next step would be to introduce simulations which are still a low-risk activity, as a means for people to examine their bias in interacting with people who are "different." In addition, the simulations begin to move the teacher candidate toward a more process-oriented cultural learning style. A particularly effective method would be American contrast exercises. Since these are most effective when conducted with an international group, it may be helpful to forge an alliance with international student organizations on the campus to involve those students in the process. As American-born teacher candidates interact with the international students, they begin to recognize their own cultural beingness, and the international students reap the benefit of having their own culture validated. This provides a valuable bonding for the American-born candidates that will serve them well at Level Two. By the end of Level One, there will be the beginnings of a relatively safe environment in which teacher candidates begin to explore the nature of culture, as it manifests itself in themselves, and begin to recognize and acknowledge their ignorance and ethnocentrism about other cultures.

Level Two

Level Two manifests both process and product. While it still has workshops and courses on specific populations, they are more integrated into the curriculum; and the curriculum, as whole, has a broadening conceptual framework for incorporating multiculturalism into the school's program. A multicultural approach to education works well at this level. The type of exercises that will facilitate the development of an educational program operating at Level Two to

expand to Level Three is different from those at Level One. Following the ICW format, we find at this level a great deal of self-awareness being developed. The culture bump methodology serves this function very well. After having examined the nature of culture, ethnocentrism and communication (or lack of it) within the relatively low-risk area of international relations, the participants are now ready to examine their ignorance and prejudice about various ethnic groups within the United States. In fact the first ethnic group that they study is their own. At this time, we can also see the three skills defined by Geneva Gay being developed. The culture bump methodology provides the structure for the teacher candidates to examine their own cultural expectations of teachers and students in the classroom—based on actual experience. This removes those expectations from the realm of normal behavior and places them in the arena of cultural reactions, thus giving the teacher candidate the objectivity needed to redesign his or her teaching style and techniques to reach all the children in a classroom. It is also at this level that culture specific information, or single group studies focused on specific groups—including White Americans—should be introduced. While the individual reflection process continues, the teacher candidates learn how to assess racist, sexist, and elitist overtones in textbooks and other materials while doing in-depth study of various ethnic groups including their own. Teacher candidates, having been trained in using the culture bump, will be able to learn about differences in others without having those differences reinforce stereotypes. This begins to prepare students to fulfill Banks' (1973) goal to

> ...develop the ability to make reflective decisions so that they can resolve personal problems, and through social action, influence public policy and develop a sense of political efficacy. (p. 152)

Level Three

By Level Three, with its process innovations from Level Two and philosophical orientation, we find little need for cross-cultural methodology since the goal to create an environment in which students are empowered to create their own learning situations has been reached.

At this level, we find a program in which an approach for education that is multicultural and social reconstructionist spontaneously occurring. Upon reaching this level, students have been given the tools to continuously identify and rectify their own cultural blind spots and can, as a group and as individuals, uncover their own strengths. At this point, most exercises are in the form of practicums—with professors taking the role of mentors and guides—as student candidates begin to pass on their experience to others. At this time, they can, as part of their coursework, begin to redesign the teacher preparation program to more closely resemble a multicultural program. Their contributions reinforce the institution's commitment to multiculturalism. Teachers would now demonstrate the skills that Gay defined as necessary for effective teaching in a multicultural environment.

Results of a Comprehensive Teacher Education Program

Let us look at results of a systematic integration of cross-cultural communication methods into a multicultural teacher preparation program. A neutral or safe environment would be created in which people can examine honestly their own ethnocentrism, racism, and prejudices—always within the context of moving beyond these self-damaging and other-damaging attitudes and beliefs. There would be a focus on developing the skill of communicating—in all its implications—with people who are different. A vision of an America in which perfect multiculturalism existed—an America in which cultural diversity is respected, ethnocentric and prejudicial attitudes have been overcome, degrading poverty and dehumanizing dependency have been eradicated and all people have developed a meaningful identity would become the shared vision that guides the newly prepared teachers. With the discovery of their group and individual vision, participants are ready to be educators for the children of this new society.

And what kind of teachers would emerge from this educational program? We would find: teachers who are committed to humane ideas; and, even more importantly, teachers who have the ability to go beyond their own prejudices to act out of their commitment to the ideals expressed; teachers well armed with a variety of tools that help

them to evaluate their own reaction to the cultural differences, as well as a solid base of information about the various ethnic and cultural diversity to be encountered in the United States; teachers who have fully explored for themselves what it means to be American, what it means to be cultural as well as diverse from one another, and ultimately, what it means to be human; and teachers who are ready to:

> ...help students develop a better understanding of their own backgrounds and of other groups that compose our society... help students to respect and appreciate cultural diversity, overcome ethnocentric and prejudicial attitudes and understand the socio-historical economic and psychological factors that have produced the contemporary conditions of ethnic polarization, inequality and alienation... help them conceptualize and aspire toward a vision of a better society and acquire the necessary knowledge, understanding, and skills to enable them to move society toward greater equality and freedom, the eradication of degrading poverty and dehumanizing dependency, and the development of meaningful identity for all people. (Suzuki 1979, pp. 47-48)

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Part II:
Multiculturalism in Learning and Instruction

5

Examining Teaching Styles and Student Learning Styles in Science and Math Classrooms

James A. Anderson

During the last decade a tremendous amount of concern has been generated concerning the poor performance of United States students on various assessments of science and mathematics achievement as compared to students from countries like Japan, West Germany, France and the United Kingdom. A number of reports, including *A Nation at Risk* (1983) and *Educating Americans for the 21st Century* (1983), have examined the state of U.S. science and mathematics education and have cited the need for education to produce scientifically and technologically literate individuals. There are numerous motives which support the expression of these comments; and among these are concerns about the waste of human talent, fears of a projected shortage in qualified science and math instructors at the precollege and undergraduate levels, the decline in the science and engineering labor pool and related technical fields, and the inability to keep pace with other countries concerning scientific and technological supremacy.

Whereas the aforementioned discussion examines the national crisis within science and mathematics education, recently more attention has been paid to the underrepresentation of ethnic minorities and women among such disciplines. This focus is fueled by U.S. Census and demographic reports which contend that by the year 2000, approximately 85% of the new entrants to the U.S. labor force will emanate from diverse populations. Presently, Blacks and Hispanics represent 25% of the precollege level; and, by the year 2000, they will comprise 47%. Some 23 of the 25 largest school systems in the U.S. are majority-minority school systems, that is, those in which students from minority groups predominate (Woodside 1986).

There is no argument to the contention that Blacks, Hispanics, and women are traditionally underrepresented in the science, mathematics, and engineering disciplines. In 1988, Blacks accounted for 2.6% of all employed scientists and engineers, Hispanics were 1.8%, and women were 16%. Concomitant with the underrepresentation and the recent downturn, the persistence rate (until graduation) of Blacks and Hispanics in the sciences has been 29%, as compared to the national total of 79% (Congressional Research Service 1990). Asian Americans are not statistically underrepresented, nor do they evidence low persistence rates.

Among the factors which have been cited as causes of this dilemma are the following: disparities in academic preparation and competition, limited resources to fund science and math training, failure to restructure science and math curriculums, deficient interactions between minority students and role models, students' negative attitudes towards science, students' unrealistic perceptions of their skills and abilities, teacher perceptions which are negative or discriminatory, and lack of quality in science instruction. Although all of these are important variables and some are more operative than others depending on the situation, the focus of this chapter will be upon the nature of the classroom dynamics which facilitate or impede science and math education at the precollege level. In particular, the emphasis will be placed upon the teaching-learning dyad. In addition the examination of diversity within (and between) the instructional styles/strategies of teachers will be compared with the preferred learning styles and characteristics of diverse students, especially students of color.

The Educational Pipeline Begins in the Classroom

Although many efforts have been undertaken to improve the quality of science and math education among school systems, it is still the case that many have failed to create a learning environment that is exciting, challenging, and which meets and takes into account the needs of diverse learners. School systems should identify and encourage high-ability students of color, and at the same time attract those with less ability but who are high in motivation and potential. Thus the educational model for science and math should be one which promotes equity.

Although there has been some improvement in the past years in the high school completion rates of students of color, they are still overrepresented in the vocational tracks and underrepresented in academic programs, especially those related to science and math. High school science and math courses are duplicated in many of the introductory college courses. There is a clear advantage for those students who have an earlier preparation in those areas. Research by Hilton and Lee (1988) suggests that early preparation and commitment are critical variables:

> Fortifying high school mathematics and science preparation, while introducing young people to the intrinsic interest of these fields above and beyond the drudgery which typifies their perception, would have better social payoff than subsequent efforts to entice undergraduates into [science, mathematics, and engineering]. Our evidence is that more students move into sciences earlier than later, when curricula options are still available and mobility is not discouraged either by institutions, stringent curricular requirements, parents, or peers. At later stops in the educational pipeline, science attracts few newcomers and mainly battles to hold old adherents. (p.523)

Precollege (K-12) science and math instruction has an important relationship to the future career pathways of students of color and to the future supply of science personnel in the U.S. The quality of instruction has considerable influence on student interest toward perceptions of science and math. A 1986 National Science Teachers Association study found that the majority of science teachers in their respective disciplines identify their qualification as adequate or minimal (Congressional Research Service 1991). On average, science on the K-6 level is taught for approximately 15 minutes a day and directly from a textbook. In addition, it was reported that 80% of elementary teachers saved science instruction for the last period of the day, the time when students tend to be the least attentive.

The research on mathematics education is as dismal and unsettling as is that for science. Mathematics is the basic discipline for science, engineering and general technical literacy. A 1989 report by the National Research Council, *Everybody Counts: A Report to the Nation on the Future of Mathematics Education,* stated that the majority of students leave school lacking sufficient preparation in mathematics to meet job prerequisites or undergraduate requirements for math-

ematical literacy. Another report in 1985, *Second International Mathematics Study*, prepared by the Washington National Center for Education Statistics reports that among 20 industrialized and less-developed nations, U.S. students ranked 8th in statistics, 10th in arithmetic, 12th in algebra, 16th in geometry, and 18th in measurement. Japanese students ranked first in all five categories.

The Teaching-Learning Model of Mathematics and Science Education

Effective teaching cannot be just the delivery of information but rather a model of the mind at work. Excellent teachers are those who involve students in learning how to learn. This generative process of learning is especially important when the course content is abstract or technical. Science and math education at the precollege level must incorporate new ideas and strategies concerning instructional competency. A new model should identify what teachers and students bring to the learning environment that can be used as springboards to propel students to higher levels of learning. For example, we need to be able to answer questions like "What is the nature of teaching styles and strategies which facilitate the learning of science and math among students of color?" "Do students of color process information in the classroom in ways which impede their learning of abstract content?" and, "How do we help students of color become better problem solvers, reasoners, and critical thinkers?"

One of the largest challenges teachers face is to be tolerant and perceptive enough to know when students might learn differently or in an unconventional way. Differences in learning (or learning styles) do not imply deficit, especially when associated with students of color. Whereas some students do have genuine difficulty when trying to learn, there are others who capture their understanding in different ways and do not experience difficulty. For example, one student may make rows of circled sticks in order to simplify an equation. Another may insist, "Hey, let this guy here be the denominator." These students may lack important information about how they are expected to do math or use language in school, but these differences alone do not make them candidates for lower math groups.

Teaching Styles and Strategies

A plethora of activities is associated with instructional competency in general and competency in science and math in particular. However, an effective education model does not simply ask, "Which ones are most effective?"— rather it explores efficacy relative to the skills, assets, needs, and characteristics of the students who are being taught. This suggests that there is no singular normative model of teaching and learning. Thus, a discussion of teaching and the culture of a school can focus not only on how it is, but more importantly how it could be. Asa Hilliard (1976) offered an alternative model of how an effective school *can be* especially for students of color in Table 1.

Hilliard further contends that schools currently exist with instruction broken into separate, independent subject areas, standardized testing, uniform curricula, and interactions between student and work-

Table 1. The Learning Style of the School

School as it is in general	School as it could be
Rules	Freedom
Standardization	Variation
Conformity	Creativity
Regularity	Novelty
Memory for specific facts	Memory for essence
Normality	Uniqueness
Precision	Approximate
Atomistic	Global
Egocentric	Sociocentric
Convergent	Divergent
Controlled	Expressive
Universal meanings	Contextual meanings
Direct	Indirect
Cognitive	Affective
Isolated	Integration
Scheduled	Targets of opportunity
Object-focused	People-focused
Constant	Evolving

book emphasized, all of which are manifestations of the atomistic-objective style. This style breaks experience and learning into its parts or atoms, separating a person from the experience, preferring regularity, environmental control, and objectivity by placing little value on the meaning of an event. A teaching style which values this approach would be more receptive to students who exhibit parallel learning styles. It has been suggested that this style represents a more traditional one, and one which is not highly motivating to many students of color.

At the other end of the continuum is a teaching style which emphasizes the relevance of information to the student, improvisation and intuitive thinking, creativity, and the synthesis of divergent experiences. This style seems to match better the learning styles of many diverse students. A growing body of literature exists a growing body of literature which suggests that modifications in instruction which are congruent with the learning styles of students of color can produce positive results (Willis 1989).

If one were to examine the characteristics of *successful* mathematics and science programs for African American, Hispanic, and Native American students at either the precollege level or the freshman year in college, one should expect to find an overlap among the characteristics associated with effective teaching. Table 2 identifies some of these factors.

For too many students of color, math and science become increasingly difficult because the students may not know how to make new and unfamiliar information more meaningful. Effective teachers can show students how to use analogies by thinking about other things they know which might relate to new information. For example, suppose a student was trying to learn the difference between arteries and veins. The student might know something about household plumbing and be able to relate this new information to water pressure and the way a sink works. Although the two structures and the way they work are not exactly the same, there are enough similarities so that the old knowledge about sinks, clean water, and draining out dirty water could help the student to grasp how the heart, arteries, and veins work. Creating analogies helps students to make a mental bridge to new information. In her research on effective teaching, Willis (1989) suggested that minority students can become more analytical when math and science are centered around natural, logical topics of life. For example, elementary students can be taught

to negotiate their immediate environment (say, from home to school) by being taught map skills, measurement, math skills to do the measuring or counting, social studies skills about neighborhoods, and art projects to create collages and three-dimensional neighborhood models. This represents a holistic model of teaching and learning.

Table 2. Characteristics of Effective Mathematics and Science Instruction for Students of Color

The teacher:

- Fosters a sense of community grounded on the shared experience of doing serious work
- Utilizes student feedback to periodically assess teaching ability
- Individualizes and personalizes classroom presentations when necessary
- Introduces relevancy of information to be learned
- Provides students with hands-on activities and involvement
- Provides appropriate feedback when students experience conceptional difficulties
- Acknowledges developmental level of students and teaches to that level
- Varies instructional method
- Encourages students to express their reasoning process in their own words (especially futility)
- Guides students in learning how to frame new questions
- Guides students in the use of alternate learning strategies
- Shows connections between isolated pieces of information

For many teachers of math and science at the precollege level, the challenge is to demystify each discipline so that students are better able to effectively engage the material. Undoubtedly, some type of bonding process will also have to develop between teacher and student. Many teachers may seek to go even further by utilizing strategies which establish a link between ethnic identity and academic excellence.

Learning Styles

There is a significant body of literature which has emerged in the last two decades that suggests that the learning styles of students of color, especially those which are strongly culture-bound, influence how they learn in the classroom. Cooper (1981) has highlighted the impact of stylistic differences in language among Blacks. Ramirez and Price-Williams (1974) have focused on the cognitive styles of Hispanic children. In all situations, a strong case is presented for the modification of educational systems in response to the uniqueness of these styles.

In America, many White children move through the educational system and then into the workworld; and the development of cognitive and learning styles follows a linear, self-reinforcing course. On the other hand, for children of color, learning to be bicultural is not a free choice, but a prerequisite for successful participation in school. Many children of color are expected to be bicultural, bidialectic, bicognitive, and to measure their performance against a European American yardstick.

For these students, science and math education can cause a potential conflict in style. How students process the abstract content of math and science is strongly influenced by their learning style. Moore (1984) reported the work of Schindler and Davison, who discuss the difficulty of Native American students with math because of two critical factors: the perceived utility of mathematics and the direct relationship of mathematics learning to language development. They suggested that factors related to math education of Native Americans that must be considered include math avoidance due to stylistic conflict, distinguishing nuances of meaning in the English language, and mathematics vocabulary in the Native American language. Moore (1988) showed how a cultural activity, the making of

string figures, is evidence of mental characteristics that can impact positively upon modern Native American mathematics students.

Anderson (1988) has looked at the differences between relational and analytical learners. Many students of color take different approaches to learning math and science. Table 3 compares those two types of styles.

Table 3

Analytical Style	Relational Style
1. Able to disembed information from total picture (focus on detail).	1. Perceive information as part of total picture.
2. Exhibit sequential and structured thinking.	2. Exhibit improvisational and intuitive thinking.
3. Learn material which is inanimate and impersonal more easily.	3. Learn materials which have a human, social content and which are characterized by experimental/cultural relevance.
4. Good memory for abstract ideas and irrelevant information.	4. Good memory for verbally presented ideas and information especially if relevant.
5. More task-oriented concerning academics.	5. More task-oriented concerning non-academic areas.
6. Performance not greatly affected by the opinions of others.	6. Performance influenced by authority figures' expression of confidence or doubt in their ability.
7. Show ability to persist at unstimulating tasks.	7. Prefer to withdraw from unstimulating task performance.
8. Style matches up with most school environments.	8. Style conflicts with traditional environments.

What the preceding table suggests is that students who utilize a learning style which leans more towards the relational/holistic/affective dimension may encounter problems when they attempt to adapt their styles to the theoretical, often abstract, reasoning process utilized in mathematics and the natural sciences. Many instructors utilize a format in which the teaching of the theory and concepts (in an abstract sense) precedes or dominates any discussion of practical application, direct experience or relevance, and social significance.

One of the more successful precollege science programs which builds upon the cultural and cognitive assets of Black students is the Stress on Analytical Reasoning (SOAR) program at Xavier University in New Orleans. The program builds confidence and skill in its predominantly Black population by creating an aura of family in which cooperation is highly valued, bonding between the faculty and students in encouraged and expected, and maintenance of positive ethnic identity is fostered. Learning occurs in a socially-reinforcing environment as peer interactions flourish. Faculty utilize teaching styles which mold the abstract course content to meet the information processing needs of the SOAR students.

School-College Collaborations

The best antidote to poor math and science preparation at the middle and high school level is to give students the help they need to succeed *before* they start to lag behind. A number of early intervention programs has evolved, primarily in the last two decades, some aimed at gifted and talented students; others targeted for those who are disadvantaged or at-risk. The format of such programs varies, including college level study in high school, academic and college counseling, tutoring and skills building, summer programs, and other precollege experiences. The secondary schools may establish arrangements with organizations, professional schools, community colleges, colleges, and universities.

The curriculum associated with many collaborative efforts resembles the one established by the Student Educational Enrichment Program (SEEP) at the Medical College of Georgia. This is a program for high school students to enrich their academic background, espe-

cially in the sciences, and to encourage and interest them in pursuing a career in the health sciences (Thurmond & Mott 1990). Students take college-level courses in biology, medical writing, analytical reading, and mathematics. All courses are preceded by study skills workshops. Students receive career information, tutoring, mentoring and extracurricular services. In most programs, the criteria for admission are based upon cognitive and noncognitive information.

A similar program is the Wright State Engineering Preparatory Program (WRIGHT STEPP) which was initiated in the summer of 1988 on the campus of Wright State University. It involves forty students each from the 7th, 8th, 9th, and 10th grades in the Dayton Public School System. The group spends six weeks on the campus taking courses in pre-algebra, communications, computers, and geometry; listening to role model speakers; taking tours of local engineering-oriented industry and participating in hands-on laboratory learning sessions. The courses are taught by teachers who were urged to individualize and personalize their presentations. The laboratory sessions are led by a number of volunteers from a nearby Air Force Base and Electronic Supply Center, thus adding a third asset to the collaborative effort.

Cross-cultural, cross-ethnic teaching and learning occurs when the persons interacting are of different cultural or ethnic identities. Moreover, when one adds to this equation the differences in degree of acculturation and type of cognitive/learning style, then the input which affects teaching styles and strategies becomes more complicated. Educators and professionals need to re-examine the belief systems and values which underscore the training of educators so that they include a different set of understandings about the way diverse populations communicate, behave, and think.

We need to be willing to ask and answer the tough questions which concern the performance of diverse students in the classroom. What makes the questions difficult is that we must include all factors (the learning context, the content, the teacher, the learner) as we attempt to generate answers. In some ways, math and science education at the precollege level is grossly underdeveloped in the United States. The task of educators is to begin to erect the structures which appreciate and value the disparate ways students desire to learn.

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6

A Comparative Study Between Italian and Korean Students' Methods for Solving Word Problems

Woo Hyung Whang

An extensive body of research has been accumulated on the importance of language in the learning and teaching of mathematics (Zepp 1989). Several categories can be identified in these research studies. Most of the research has paid attention to bilingualism and mathematics education (Alladina 1985; Cuevas 1984; Dawe 1983; Jurdak 1977; Lladre 1983). Other researchers have analyzed the role of language (mainly English) in the learning and teaching of mathematics (Call & Wiggin 1966; Janssen 1974; Roberge & Craven 1983; Zepp 1981). Only a few of these studies have been conducted with other languages, especially those of non-Western countries (Zepp, Monn, & Lei 1987; Zepp 1982).

In Western countries, many researchers have studied mathematical word problems, because they pose difficulties for both teachers and students. One main focus of these particular studies has been to identify the difficulties in solving word problems as compared to purely computational problems. Although many researchers have studied mathematics word problems in many countries, there is a lack of comparative studies concerning the language and curriculum-related differences in solving these types of problems, regardless of grade levels. Since word problems are always written in a certain language, the effect of language needs to be considered in any application of the results of these studies to other countries or language groups. According to the Sapier-Whorf hypothesis (Whorf 1956), each individual language has a framework which affects the speakers' formulation of concepts and ideas. In other words, the background linguistic system is the shaper of ideas, the program and guide for an individual's mental activity. Differences in curriculum, involving the importance of math-

ematics and the level or topics taught at a certain grade, could also affect the degree of difficulty of a problem for students from different countries. Since these factors can contribute to the differences in student ability to solve word problems, these differences, along with the rationale behind these differences, need to be identified. Without this process, it would not be legitimate to apply a study from one country or language group to another.

As an initial step, the focus of the present study was to identify the differences or similarities between Korean and Italian students' methods of solving word problems. In order to accomplish this goal, this study was designed to replicate an investigation done with Italian students by Fischbein, Deri, Nello, and Mario (1985). This study explored the role of implicit models in student ability to solve multiplication and division word problems. Implicit models are the intuitive sets of steps one uses to conduct a mathematical operation. These models can be instinctive or learned. For example, in the area model of multiplication, 2×5 is translated into the area of a rectangle with the dimensions of 2 by 5. In the present study, one implicit model for multiplication and two implicit models for division were examined. The selected multiplication model was the *repeated addition* model. In this model, the operand is added to itself the number of times indicated by the operator. For example, to multiply 2 times 5, one would add the number 2 to itself five times. The two selected models for division were the *partitive* and *quotative* models. In the partitive model of division, an object or collection of objects is divided into a number of equal fragments or subcollections. In the quotative division model, one seeks to determine how many times a given quantity is contained in a larger quantity.

This attempt to identify the implicit models Korean students use in solving multiplication and division word problems is important for Korean teachers and educators, as well as for American elementary school teachers who have Korean American students. Accordingly, the results of this study will contribute to not only Korean mathematics education, but also to multicultural education in the United States. The research question of the study is: *Do Korean students use the same implicit models as Italian students when solving multiplication and division word problems?*

Summary of Fishbein's Study

Fischbein, Deri, Nello, and Mario (1985) have studied the role of implicit models in solving multiplication and division word problems with Italian students. The subjects of this study were 228 students in the fifth grade, 202 in the seventh grade, and 198 in ninth grade from thirteen different schools in Pisa, Italy. The total number of subjects was 628.

A 42 item test was constructed with 12 multiplication problems and 14 division problems. Sixteen addition and subtraction problems were included to reduce the likelihood of unintentional correct answers. The multiplication and division items were mixed and the addition and subtraction problems were scattered among them. The 42 items were then divided into two forms, A and B, containing 21 items each. These forms were distributed randomly in the classrooms. Students were asked to set up the problem solution, but not to carry out the calculation.

The findings of Fischbein *et al.* confirmed that the Italian students used the repeated addition model of multiplication and the partitive model of division. The quotative model of division influenced the pupils' choices only at the ninth grade level.

Design of the Present Study

The subjects were 913 students from four different schools, two elementary schools and two middle schools, in Seoul, Korea. There were 312 subjects in the fifth grade from two different elementary schools, 299 subjects in the seventh grade, and 303 subjects in ninth grade from two middle schools. One middle school was all-male, the other was all-female. Generally speaking, the four schools were average in terms of academic achievement and reputation, even though their levels were slightly different. Elementary school X seemed to have a better reputation than school Y, and the all-female middle school was slightly below average among middle schools in general.

The 12 multiplication word problems and 14 division problems from Fischbein *et al.'s* study were translated into Korean. Every effort

was made to minimize the errors or gaps due to translation. Any word or unit that was not familiar to Korean students was changed to the proper word or unit in order to maintain the levels of difficulty. For example, the unit *quintal*, which is not familiar to Korean students, was changed to the equivalent Korean unit. However, the numbers and basic context in each problem were unchanged. In this study, no addition and subtraction problems were included, because Fischbein *et al.* (1985) did not report the problems that they used. However, the multiplication and division problems were mixed and randomly divided into two forms (Forms A and B), containing 13 items each (see Appendix Table 1).

The intent was to use exactly the same procedure as used in Fischbein *et al.'s* study (1985); however the two elementary schools misunderstood the procedure. Six classes were involved in each elementary school, instead of three classes in each school. Therefore only half of each class took a test. In the two middle schools (grades 7 and 9), the tests (Forms A and B) were distributed randomly in the classroom, and each student responded to only one version (A or B). As in Fischbein *et al.*, they were asked to indicate the operation needed to solve the problem, not to implement the actual calculation.

Results of the Study

The results indicated that there was no significant difference between the fifth grade and seventh grade ($p = .09$) and the fifth grade and ninth grade ($p = 0.055$). In both the seventh and ninth grades, females achieved higher scores than males (see Appendix Table 2).

Whole Number Operands and Operators

In Problems 1 and 2, both the operators and operands are whole numbers (see Appendix Table 3). Almost all of the students answered these problems correctly in both studies (Fischbein *et al.'s* and the present study). In both studies, the large operand in Problem 2 had no significant effect on problem difficulty, except in the Italian fifth grade. These students scored much higher on Problem 2 than on Problem 1.

Caldwell and Goldin (1987) studied the relative difficulties of four types of word problems: abstract factual, abstract hypothetical, concrete factual, and concrete hypothetical. Their developmental theory suggests that concrete factual problems are the easiest, abstract factual and concrete hypothetical problems are intermediate, and abstract hypothetical are the most difficult for elementary students to solve. In this study, Problem 1 was hypothetical and Problem 2 was factual. Since the fifth graders were the youngest students involved in the study, it seems logical that they would have difficulty with Problem 1. However, it was only the Italian students that were affected, not the Koreans. In other words, the Korean fifth graders were not affected by the length or hypothetical statement of the problem. One possible explanation for this result is the different levels of mathematics competence of the two groups. On the 26 multiplication and division problems, the Korean fifth graders performed better on 20 of the problems than did their Italian counterparts, and the two groups performed equally as well on the remaining six problems. Therefore, the Italian students did not outperform the Korean students on any problem of the total 26. It is possible, then that the Korean students were less affected by the lengthy, hypothetical statement in Problem 1, because of their higher level of mathematics competence.

Whole Number Operators Versus Decimal Operators

The numbers in Problems 3, 4, and 5 are identical; but the operator of Problem 3 is a whole number, and those of Problems 4 and 5 are decimals. Problems 4 and 5 are in conflict with the repeated addition implicit model. For example, Problem 4 requires the student to multiply 15 by 0.75. To complete this operation using the repeated addition model, one must add the number 15, 0.75 times. Therefore, the repeated addition model requires the operator to be a whole number. In both studies, Problem 4 and 5 were more difficult for the students than Problem 3 at all grade levels. However, the Korean students had less difficulty solving Problems 4 and 5 than the Italians at each grade level. These results support the conclusion that a decimal operator is a source of difficulty. However, the decimal operators did not perturb the Korean students as strongly as the Italian

students. Problem 4 was easier than Problem 5 for the Italian students, but Problems 4 and 5 had the same level of difficulty for the Korean students. Fischbein *et al.* (1985) explained that the severe difficulty of Problem 5, especially for the younger students, might be attributable to their unfamiliarity with the content of the problem, particularly the notion of *detergent*. However, the Korean students performed almost equally on both problems at each grade level although they also were unfamiliar with the word *detergent*. In this case, unfamiliarity of content had no effect on the Korean students. Considering that the Italian students had more difficulty solving Problem 3, which is not in conflict with the repeated addition model, they seemed to be more influenced by the unfamiliar content. The differential effects of the word *detergent* could be a result of the different levels of mathematics competence between the two groups.

Size of Operand

Comparison of the data from Problems 4 and 6 in Fischbein *et al.'s* study generated the conclusion that the size of the operand was not critical when the operand was a whole number. Problem 6 uses the same numbers as Problem 4, but in Problem 6, the size of the operand has been increased from 15 to 15000. The present study revealed similar results, but the Korean students consistently recorded slightly lower scores on Problem 6. In addition, the older Korean students had more difficulty solving both Problems 4 and 6. Therefore, the Korean students seemed more affected by the size of the operand than the Italian students.

Unfamiliar Decimal Operators

Fischbein *et al.* (1985) conjectured that an unfamiliar decimal, like 0.65, would cause students greater difficulty than a familiar decimal like 0.75. The data from the Italian students supported this hypothesis, but the data from the Korean students did not. Problem 7 (1500×0.65) was easier than Problem 6 (1500×0.75) for the Korean fifth and ninth graders. The Korean seventh graders performed almost equally as well on the two problems. It seemed that the wording of

Problem 7 helped the Korean students to understand better the problem. The description of Problem 7, involving the word *price*, was typical of a Korean mathematics textbook. Therefore, the Italian students had difficulty solving Problem 7, since the decimal 0.65 was unfamiliar to them; and Problem 7 was easier for the Korean students because of its familiar wording. However, an explanation is still needed as to why the Korean students were not affected by the presence of 0.65 and the Italian students were. This difference may be attributable to the Italian students' lower levels of mathematics competence. It is more difficult to round 0.65 than 0.75. Korean students, with their higher competence levels, were able to equate the two decimals, whereas the Italian students could not.

Decimal Operators and the Absorbing Effect

Problems 8 and 9 were constructed to test the view regarding decimal operators. The numbers involved in both problems were the same, but they had different roles. In Fischbein *et al.'s* study, changing the number 1.25 from operand to operator reduced the number of correct answers almost in half at each grade level. In the present study, the Korean seventh and ninth graders were disturbed by the changing roles of the two numbers, but it was not as significant as with the Italian students. The Korean fifth graders performed almost equally as well on both problems. These results can be explained by the Korean mathematics curriculum. After sixth grade, students no longer study arithmetic, including multiplication and division of decimals and fractions. Accordingly, the Korean seventh and ninth graders seemed to have more difficulty solving Problem 9. On the other hand, Korean fifth graders actively study multiplication of decimals. As a result, the fifth graders were less affected by the changing role of operand and operator. In both studies, the seventh graders received the lowest score, the ninth graders the next lowest, and the fifth graders had the highest scores. The ninth graders outscored the fifth graders because they were mathematically mature enough to better understand decimal operation, although they were no longer actively studying it.

Fischbein *et al.* conjectured that when the whole part of a decimal is clearly larger than the fractional part, students may treat it more like a whole number (as though the whole part masks or absorbs the

fractional part). Problems 10 and 11 consist of the same numbers, 15 and 3.25, but they had different roles in each problem. In Fischbein *et al.'s* study, the differences in difficulty between Problems 10 and 11 were smaller than those between the problems comparing whole number and decimal operators (Problems 8 and 9 or Problems 3 and 4) at each grade level. In this study, the results were the same only for the Korean seventh and ninth graders. For the Korean fifth graders, the differences in difficulty between Problems 8 and 9 (2%) were smaller than those between Problems 3 and 4 (8%) or Problems 10 and 11 (11%). In other words, the results of the Korean fifth graders could not be explained by this absorbing effect. These results imply that students with higher levels of mathematics competence are less likely to be affected by the absorbing effect. Therefore, the Korean fifth graders were not affected by the ratio of the whole part to the fractional part of the operator.

In Problem 12, the fractional part of the decimal is substantially larger than the whole part (3.70). In Fischbein *et al.'s* study, the absorption effect did not operate as strongly in Problem 12 as in Problem 11 at Grades 5 and 7. The Italian ninth graders performed equally as well on both problems. Fischbein *et al.* assumed that this was because the ninth graders had learned to round decimals such as 3.70 to 4. In this study, the results were the same for Grades 7 and 9. The Korean fifth graders even did slightly better on Problem 12 than Problem 11.

In summary, comparison of the two studies suggests that there are differences between the Korean and Italian students. The Korean students had less difficulty solving multiplication problems containing decimal operators than did the Italian students (Problems 3, 4, and 5). In this case, unfamiliarity of content had no effect on the Korean students at each grade level (Problems 4 and 5). For the Italian students, the decimal operator 0.65 was less familiar and therefore more difficult than 0.75, but this was reversed for the Korean students (Problems 6 and 7). In addition, the Italian students were more sensitive to decimal operators than the Korean students at each grade level (Problems 8 and 9). The Korean fifth graders not only performed better overall than the Korean seventh and ninth graders (Problems 1-12), but they also were less perturbed by decimal operators than all of the other grades (Problems 3, 4, 8, 9, 10, 11, and 12). On the other hand, the Italian fifth graders performed better than the other grades

on only four problems (Problems 3, 4, 7, and 9). Generally speaking, the Korean students outperformed the Italian students on the given multiplication word problems. The Korean students performed better in 26 out of 36 (12 problems × 3 grades) comparisons, and they performed equally as well on 11 problems.

In conclusion, the Korean students seemed to use the same implicit model (repeated addition model) as did the Italian students. However, the Korean students were less affected by this intuitive implicit model than their counterparts. As a result, the Korean students were able to perform better than their Italian counterparts on the given multiplication problems.

Partitive Division with Large Whole Number Dividends and Small Whole Number Divisors

Problems 13, 14, and 15 address the partitive division implicit model (see Appendix Table 4). In this division model, an object or collection of objects is divided into a number of equal fragments or subcollections. This implicit model requires that the dividend is larger than the divisor; the divisor is a whole number; and the quotient is smaller than the dividend (Fischbein *et al.* 1985). In Fischbein *et al.'s* study, the Italian fifth and ninth graders showed differences in their abilities to solve the three problems. Problem 15 was the most difficult for the Italian fifth graders; whereas Problem 14 was the hardest for the Italian ninth graders. The Italian seventh graders found the three problems to be equally difficult. Fischbein *et al.* assumed that the fifth graders' low scores on Problem 15 were due to either the presence of a large number or the symbol *hg*. (In the present study, the unit *kg* was substituted, as the unit *hg* was unfamiliar to the Korean students). In the present study, the Korean fifth graders had the most difficulty with Problem 14. The degrees of difficulty of Problems 14 and 15 were almost equal for the Korean seventh graders. The Korean ninth graders had more difficulty with Problem 15 than any of the other problems. For both the Italian and Korean students, Problem 15 was the easiest one at each grade level. The numbers in Problem 13 (75, 5) seemed more familiar than those of Problems 14 (96, 8) and 15 (1500, 3) and the context of Problem 13 was easy to visualize. When Problems 14 and 15 are compared, the context of Problem 14 is easier to visualize, but

the divisor (8) appears before the dividend (96) which may be confusing to students. On the other hand, Problem 15 not only has a large dividend (1500), but it also contains the measurement of weight which is difficult to visualize. However, in Problem 15, the dividend appeared before the divisor and therefore the problem was easier.

Overall, the Italian ninth graders and the Korean fifth graders had difficulty solving problems with reversed order of dividend and divisor, and the Italian fifth graders and Korean ninth graders had difficulty solving problems with large numbers and measurement context that was not simple to visualize. The Korean and Italian seventh graders found Problems 14 and 15 to be equally as difficult.

Partitive Division with Small Whole Number Dividends and Large Whole Number Divisors

Problems 16 and 17 were designed to violate the partitive division model's rule that the divisors must be larger than the dividends. This violation reduced the frequency of correct answers significantly at all three grade levels in both studies. However, the Korean students were less affected by this violation. They scored much higher than the Italian students at each grade level. In both studies, Problem 16 was easier than Problem 17 for the fifth and seventh graders, and the ninth graders scored almost equally as well on both problems. Since the wording of the two problems is identical and only the numbers are changed, it seemed that younger students had an easier time with the problem with a familiar combination of numbers (15, 5) rather than the one with the unfamiliar combination (12, 5). The ninth graders were able to overcome unfamiliar combinations of numbers when the wordings of the problems were the same.

Quotative Division with Large Whole Number Dividends and Small Whole Number Divisors

Problems 18 and 19 deal with the quotative division model, in which one seeks to determine how many times a given quantity is contained in a larger quantity. In this case, the only constraint is that the divi-

dend must be larger than the divisor. If the quotient is a whole number, the model then can be seen as repeated subtraction (Fischbein *et al.* 1985). For the Italian students, Problems 18 and 19 were more difficult than the partitive model division problems (Problems 13 and 14). The Korean students obtained the correct answers for Problems 18 and 19 less often than for Problem 13. Problem 14 had the same level of difficulty as Problems 18 and 19. As mentioned previously, the reversed order of dividend and divisor in Problem 14 seemed to be the cause of the difficulty. Both studies revealed that Problem 19 was harder for the students than Problem 18. The hypothetical statement and the complex content in Problem 19 seemed to be the cause of the increased difficulty. Considering that Problem 18 contains both large numbers (1400, 3500) and reversed order of dividend and divisor, it seems that both the Italian and Korean students had more difficulty solving problems with hypothetical statements and complex content.

Partitive Division with Decimal Dividends and Whole Number Divisors

In Problems 20, 21, and 22, the dividends are decimals and the divisors are whole numbers. These problems violate both of the division implicit models' rule that the divisor should be smaller than the dividend. In both studies, the students performed better on Problems 20, 21, and 22 than on Problems 16 and 17, which have the same violation (the divisors are bigger than the dividend), but the dividend is a whole number. It seems that both the Korean and Italian students ignored the decimal point (for example, seeing 3.25 as 325). However, the differences in the scores of the two groups of problems (Problems 16 and 17 versus Problems 20, 21, and 22) for the Korean students were not as significant as for the Italian students at each grade level. Among the three problems, Problem 21 was the easiest in both studies. This result suggests that problems involving persons in the context, such as "friend," and familiar combinations of the numbers were easier to solve than problems with nonhuman objects, such as *package* and *bottle*. The context of the problem had the greatest influence with the younger students. For example, Problem 21 was easily solved by

the fifth graders since the students experience *sharing* in everyday life. Comparing the ninth graders of the two countries, Problem 22 was the most difficult problem for the Italian ninth graders and Problem 20 was the hardest problem for the Korean ninth graders.

Partitive Division with Whole Number Dividends and Decimal Divisors

Problem 23 was constructed to violate a restriction of the partitive model, the divisor must be a whole number. Comparing the data from Problem 23 to that for whole number divisors (Problems 13 and 14), a drastic decline was found for both the Italian and Korean students. However, the Korean fifth and ninth graders seemed less influenced by the violation than the Italian fifth and ninth graders. The scores of Korean fifth and ninth graders were almost double that of their Italian counterparts for Problem 23.

Quotative Division with Whole Number Dividends and Decimal Divisors

Problems 24, 25, and 26 are quotative division problems with decimal divisors. These problems were much easier for both Italian and Korean students, especially the ninth graders, than Problem 23, the partitive problem with a decimal divisor. This result suggests that the negative impact of the decimal divisor is lessened in quotative problems. In both studies, Problem 26 was easier than Problems 24 and 25 in general. This can be explained by the absorption effect discussed in the multiplication section of this chapter.

In summary, the Korean students were less affected by violations to the following rules of the division implicit models: the dividend must be larger than the divisor, the divisor must be a whole number, and the quotient must be smaller than the dividend. In Fischbein *et al.*'s study, it was concluded that there is only one intuitive primitive model for division problems—the partitive model. With instruction, the students acquire a second intuitive model—the quotative model

(Fischbein *et al.* 1985). It seems that the Korean students also used the partitive model for their intuitive primitive model, but the Italian students did not use it consistently as shown by the results of Problems 13 and 14, Problems 16 and 17, Problems 18 and 19, and Problems 20, 21, and 22. In general, the Korean students performed better than the Italian students on the given division problems. The Italian students scored higher on only 6 out of 42 (14 problems × 3 grades) comparisons.

Gender

An attempt was made to identify gender differences in ability to solve multiplication and division word problems. Data were available for only the Korean seventh and ninth graders, since Korean students are segregated after the last year of elementary school (Grade 6).

On the multiplication problems, the females scored higher on 16 (67%) out of 24 (12 problems × 2 grades) comparisons. The females were also less affected by violations of the restrictions of their implicit models (Problems 4, 5, 6, 9, 11, and 12). These results suggest that it was easier for the females to overcome these violations. The males scored higher only on problems that had no violations of their implicit models (Problems 2, 8, and 10).

On the division problems, the females again (71%) performed much better than did the males. This result suggests that the females were also less affected by their implicit models when solving division problems (Problems 17, 18, 20, 21, 23, 24, and 25). Again, the males only scored higher on problems that had no violations of their implicit models (Problems 14 and 15). The females scored higher than males on the quotative division problems (Problems 18, 19, 24, 25, 26).

In summary, the females scored higher than the males on both multiplication and division problems. The females overcame the perturbation due to implicit models more easily on both types of problems. The females also had less difficulty solving the quotative division problems than did males. The males did better only on problems that had no violations to their implicit models.

Discussion of the Study

In the present study, the Korean fifth and seventh graders scored equally as well on the given problems (see Appendix Table 2). In Fischbein *et al.*'s study, the Italian seventh graders scored higher than the fifth graders. There are two possible explanations for this difference between students from the two countries. First, it could be explained by the Korean curriculum: Korean seventh graders deal with topics in basic algebra, including equations. On the other hand, Korean fifth graders work with problems similar to those used in this study. Secondly, the difference could be explained by the sampling error in this study. Only half of the fifth grade classes took a test; that is, one-half of six classes randomly took a test instead of three entire classes.

In both Grades 7 and 9, the females scored higher than the males. As was discussed in the results section on gender differences, the females not only scored higher, but they were also less affected by violations of their implicit models for both multiplication and division problems. The males scored higher only on problems that had no violations to their implicit models. In this study, the ninth grade females scored much higher than did the ninth grade males. In the United States, many researchers, as well as mathematics and science educators, have been making efforts to encourage female students to pursue mathematics and science related careers. It could be productive for researchers interested in gender issues in mathematics and science to study the Korean education curriculum, school system (especially, gender segregation after Grade 6), parental expectation and concern, and testing (college entrance exam).

The Korean students had less difficulty than did the Italian students solving both multiplication and division problems violating implicit models. It would not be simple to pinpoint why the Italian students were more disturbed by implicit model violations than the Korean students. But, it could be partly explained by the different levels of mathematics competence, attributed to differences in district curricula and language, between the two countries. It seems that additional research is needed to identify specific reasons for this result.

Since the Korean students were less affected by the implicit models, they scored much higher in general than did the Italian students. It may not be legitimate to generalize from the ability of the

students to solve the given multiplication and division problems to their ability to solve general mathematical problems. Nevertheless, the significant deviation between students of the two countries can be explained by the importance of mathematics in testing in Korea, especially, the emphasis on the college entrance examination. It seems that Korea is one of the few countries which requires higher mathematics for all students. In addition, the scores on the mathematics test are critical to college admission, regardless of the students' intended college majors. Every Korean high school student is required to take mathematics, including algebra, geometry, precalculus, and calculus, for three years. In 1990, approximately 900,000 students took the National College Entrance Exam, which is similar to the SAT in the United States. Korean high school seniors can take this exam only once a year. If they fail, which is not uncommon, they must wait another year. Every year, less than 20 % of Korean graduates can continue their studies in colleges, including junior colleges. Since college admission is so very competitive, teachers and parents of elementary students encourage them to study higher levels of mathematics. Parents of elementary students will even hire private mathematics tutors to aid in their children's success in mathematics.

It seems reasonable to surmise that the differences in achievement between the two countries could be due to mathematics curriculum, specifically the requirement of higher mathematics for every student and the importance of mathematics achievement on the college entrance examination. However, another way of explaining the differences is the application of the Sapier-Whorf hypothesis (Whorf 1956). Since the Italian and Korean students have different basic language frameworks that could affect their formulation of concepts, a portion of these differences could also be explained by the language difference.

In conclusion, the Korean and Italian students seem to have the same implicit models for solving multiplication and division problems, but the Korean students were much less affected by their intuitive implicit models. As a result, the Korean students performed better on the given problems than the Italian students. It would be productive to study more deeply and systematically the reasons why the intuitive implicit models for multiplication and division problems were less profound in Korean students than in Italian students.

Table 1. Problems Used in the Study

No.	Form	Statement*
		Multiplication Problems
1	A	On the highway a car travels 2 km in 1 minute. If the speed of the car is constant, how far does it travel in 15 minutes?
2	B	1 kg of orange costs 1500 won. What is the cost of 3 kg?
3	A	From 1 quintal of wheat you get 0.75 quintal of flour. How much flour do you get from 15 quintals of wheat?
4	A	The volume of 1 quintal of rice is 15 cm^3. What is the volume of 0.75 quintal?
5	B	1 kg of detergent is used in making 15 kg of soap. How much soap can be made from 0.75 kg of detergent?
6	A	1 m of suit fabric costs 15000 won. How much does 0.75 cost?
7	B	The price of 1 m of suit fabric is 15000 won. What is the price of 0.65 m?
8	A	For 1 cake you need 1.25 g of sugar. How much sugar do you need for 15 cakes?
9	B	For 1 kg of cake you use 15 g of sugar. How much do you use for 1.25 kg of cake?
10	B	1 piece of chocolate weighs 3.25 g. How much does 15 pieces weigh?

Table 1. *continued*

11	A	A car goes 15 km on 1 L of fuel. How many km will it go on 3.25 L of fuel?
12	B	On 1 L of fuel, a car goes 14 km. How many km will it go on 3.70 L of fuel?
		Division Problems
13	A	With 75 roses, you can make 5 equal bouquets. How many roses will be in each bouquet?
14	B	In 8 boxes, there are 96 bottles of mineral water. How many bottles are in each box?
15	B	I spent 1500 won for 3 kg of nuts. What is the price of 1 kg?
16	A	15 friends bought 5 kg of cookies together. How much did each one get?
17	B	12 friends bought 5 kg of cookies together. How much did each one get?
18	A	To buy a dollar, you need 1400 won. How many dollars can you buy for 35000 won?
19	B	The walls of a bathroom are 280 cm high. How many rows of tile are needed to cover the walls if each row is 20 cm wide?
20	A	To wrap 5 equal packages requires 3.25 m of string. How much string is needed for each package?
21	A	5 friends bought 0.75 kg of chocolate together. How much does each one get?
22	B	5 bottles contain 1.25 L of cola. How much cola is in each bottle?

Table 1. *continued*

23	B	I spent 900 won for 0.75 kg of tea. What is the price of 1 kg?
24	A	The walls of a bathroom are 3 m high. How many rows of tile are needed to cover the walls if the width of each row is 0.15 m?
25	B	To trim 1 handkerchief you need 1.25 m of lace. How many handkerchiefs can you trim with 10 m of lace?
26	A	A tailor has 15 m of suit fabric. If one suit requires 3.25 m, how many suits can he make from the whole piece of fabric?

* The original problems were in Korean.

Table 2. Average Among Grades (%)

Grade	Form A	Form B	Form AUB	Average
5				**77**
(school X)	80	72	76	
(school Y)	75	81	78	
7				**71**
(female)	80	67	74	
(male)	73	61	67	
9				**83**
(female)	88	90	89	
(male)	80	74	77	

Table 3. Distribution of Responses to Multiplication Problems

Problem No.	Operation	Grade		% Correct (Korea)	% Correct (Italy)	Chi-sq	p
1.	2 × 15	5	school X	97			
			school Y	98			
			Average	97	84	28.719	.000
		7	female	94			
			male	90			
			Average	92	96	3.334	.068
		9	female	93			
			male	94			
			Average	94	98	4.384	.000
2.	1500 × 3	5	school X	98			
			school Y	99			
			Average	98	97	0.738	.390
		7	female	87			
			male	92			
			Average	89	91	0.596	.440
		9	female	93			
			male	95			
			Average	94	99	7.595	.006
3.	0.75 × 15	5	school X	90			
			school Y	91			
			Average	91	79	15.891	.000
		7	female	83			
			male	84			
			Average	83	74	6.177	.013
		9	female	92			
			male	85			
			Average	89	76	15.749	.000

Table 3. *continued*

4.	15 × 0.75	5	school X	83			
			school Y	83			
			Average	83	57	44.192	.000
		7	female	77			
			male	40			
			Average	83	57	0.185	.667
		9	female	87			
			male	72			
			Average	80	46	61.774	.000
5.	15 × 0.75	5	school X	84			
			school Y	89			
			Average	87	27	198.391	.000
		7	female	69			
			male	51			
			Average	60	18	86.991	.000
		9	female	88			
			male	73			
			Average	81	35	108.361	.000
6.	15000 × 0.5	5	school X	77			
			school Y	83			
			Average	80	53	44.855	.000
		7	female	67			
			male	38			
			Average	53	57	0.812	.000
		9	female	80			
			male	64			
			Average	72	52	20.656	.000
7.	15000 × 0.5	5	school X	86			
			school Y	96			
			Average	91	43	146.902	.000

Table 3. *continued*

		7	female	57		
			male	45		
			Average	51	43	2.915 .000
		9	female	89		
			male	65		
			Average	77	40	69.775 .000
8.	1.25 × 15	5	school X	99		
			school Y	94		
			Average	96	84	23.202 .000
		7	female	91		
			male	92		
			Average	91	91	0.002 .963
		9	female	93		
			male	97		
			Average	95	94	0.289 .591
9.	15 × 1.25	5	school X	89		
			school Y	99		
			Average	94	54	118.927 .000
		7	female	64		
			male	49		
			Average	57	38	16.934 .000
		9	female	90		
			male	73		
			Average	82	46	70.473 .000
10.	3.25 × 15	5	school X	96		
			school Y	96		
			Average	96	91	6.607 .010
		7	female	79		
			male	90		
			Average	84	93	9.253 .002

Table 3. *continued*

		9	female	89		
			male	93		
			Average	91	98	9.795	.002
11.	15 × 3.25	5	school X	80		
			school Y	89		
			Average	85	80	2.414	.120
		7	female	74		
			male	67		
			Average	71	85	13.668	.000
		9	female	86		
			male	83		
			Average	84	86	0.269	.604
12.	14 × 3.7	5	school X	84		
			school Y	90		
			Average	87	73	16.851	.000
		7	female	77		
			male	51		
			Average	64	78	11.727	.001
		9	female	94		
			male	73		
			Average	84	87	0.269	.604

Table 4. Distribution of Responses to Division Problems

Problem No.	Operation	Grade		% Correct (Korea)	% Correct (Italy)	Chi-sq	p
13.	75 ÷ 5 (Partitive)	5	school X	93			
			schooy Y	90			
			Average	91	89	0.590	.443

Table 4. *continued*

		7 female	94			
		male	89			
		Average	91	93	0.707	.400
		9 female	99			
		male	94			
		Average	97	99	2.143	.143
14.	96 ÷ 8 (Partitive)	5 school X	75			
		school Y	92			
		Average	83	77	2.849	.091
		7 female	79			
		male	83			
		Average	81	90	7.781	.005
		9 female	91			
		male	92			
		Average	92	88	2.439	.118
15.	1500 ÷ 3 (Partitive)	5 school X	84			
		school Y	93			
		Average	89	70	26.327	.000
		7 female	73			
		male	92			
		Average	82	89	4.815	.028
		9 female	80			
		male	86			
		Average	83	95	16.198	.000
16.	5 ÷ 15 (Partitive)	5 school X	40			
		school Y	43			
		Average	41	20	26.222	.000
		7 female	59			
		male	73			
		Average	66	24	85.607	.000
		9 female	70			

Table 4. *continued*

			male	53			
			Average	61	41	19.517	.000
17.	5 ÷ 12 (Partitive)	5	school X	24			
			school Y	36			
			Average	30	14	19.072	.000
		7	female	44			
			male	41			
			Average	43	30	8.582	.000
		9	female	61			
			male	59			
			Average	60	40	128.017	.000
18.	35000 ÷ 1400 (Quotative)	5	school X	87			
			school Y	77			
			Average	82	68	14.341	.003
		7	female	91			
			male	86			
			Average	89	79	9.013	.003
		9	female	95			
			male	88			
			Average	91	94	1.355	.244
19.	280 ÷ 20 (Quotative)	5	school X	80			
			school Y	95			
			Average	87	44	113.278	.000
		7	female	71			
			male	82			
			Average	76	77	0.115	.735
		9	female	89			
			male	84			
			Average	86	80	3.517	.061
20.	3.25 ÷ 5 (Partitive)	5	school X	82			
			school Y	61			
			Average	71	73	0.178	.673

Table 4. *continued*

		7	female	86		
			male	69		
			Average	74	71	0.591	.442
		9	female	80		
			male	69		
			Average	75	84	5.636	.018
21.	0.75 ÷ 5 (Partitive)	5	school X	89		
			school Y	73		
			Average	80	85	2.217	.137
		7	female	86		
			male	78		
			Average	83	77	2.522	.112
		9	female	92		
			male	74		
			Average	83	83	0.000	.998
22.	1.25 ÷ 5 (Partitive)	5	school X	67		
			school Y	80		
			Average	74	66	4.315	.038
		7	female	61		
			male	62		
			Average	61	74	8.939	.003
		9	female	91		
			male	73		
			Average	82	70	9.241	.002
23.	900 ÷ 0.75 (Partitive)	5	school X	31		
			school Y	49		
			Average	40	22	19.777	.000
		7	female	52		
			male	28		
			Average	40	39	0.053	.818
		9	female	79		
			male	45		

Table 4. *continued*

		Average	62	29	53.008	.000
24.	3 ÷ 0.15 (Quotative)	5 school X	46			
		school Y	38			
		Average	42	22	23.753	.000
		7 female	63			
		male	53			
		Average	59	38	20.753	.000
		9 female	89			
		male	71			
		Average	80	55	35.161	.000
25.	10 ÷ 1.25 (Quotative)	5 school X	43			
		school Y	47			
		Average	45	31	10.434	.001
		7 female	51			
		male	41			
		Average	46	63	13.522	.000
		9 female	84			
		male	58			
		Average	71	79	3.822	.051
26.	15 ÷ 3.25 (Quotative)	5 school X	72			
		school Y	65			
		Average	68	41	39.532	.000
		7 female	77			
		male	85			
		Average	81	62	22.342	.000
		9 female	96			
		male	92			
		Average	94	90	2.957	.086

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7

Interrelationships Between Gender, Affect, and Retention in Science Classrooms: A Theoretical Approach

Jane Butler Kahle

Who will do science? The decision about who studies science is made—usually unconsciously—by thousands of students in their junior high school years (ages 11-14). Those thousands of individual decisions are often made by neglect—neglect of counselors to provide varied options, neglect of parents to impart realistic life expectations, neglect of teachers to provide experiences and skills, and neglect of schools to maintain a gender neutral learning environment. Later on, many White females, White males, African Americans, Hispanics, and Native Americans who initially choose to continue to study science and math will make another decision—usually voluntarily—to opt out of a scientific and/or technological career. Those two decisions—one based on neglect, the other based on circumstances beyond the individual's control—will mean that after another decade neither women nor African Americans, Hispanics, Native Americans, or Asian Americans, who together constitute 62% of our population (Finkbeiner 1987), will be adequately represented in doctoral programs in science or practicing in fields of science.

For over two decades, researchers have attempted both to elucidate factors affecting the entrance and retention rates of women in science, as well as to conduct action research designed to affect those rates. This chapter will trace that research and will propose a theoretical base that may guide further research in gender differences.

Factors Affecting Females' Choice of Science

Gender is what a culture makes of sex—it is the cultural transformation of male and female infants into adult men and women (Keller 1986, p. 122).

The concern about sex versus gender-based differences in science and mathematics is more than a semantic issue. The use of sex or gender differentiates between a biological or environmental origin for any given trait, behavior, or aptitude. For years, scholars and practitioners have argued whether the observed differences in interest and achievement of males and females in science and mathematics were inherent or were the result of acculturation. That is, were they caused by nature or nurture? Were they related to a child's sex or a result of one's gender?

Basically, the biological argument maintains that any sex differences in science aptitudes or abilities are due to differences in genetic make-up, in hormonal levels at puberty, or in developmental patterns of males and females. Kahle and Danzl-Tauer (1991) have shown that the scientific evidence for genetic, hormonal, or developmental factors contributing to achievement differences in science and math is weak or nonexistent. Therefore, the focus of this chapter is on the environmental factors that differentially affect the interest levels and the retention rates of females and males in science, and ways those factors can be affected in a systematic way through paradigm-based research.

Historical Perspective

Almost a decade ago, I began to identify factors affecting the achievement and retention levels of girls and women in science. As shown in Figure 1, I considered three general areas: educational, socio-cultural, and personality-related. Educational factors included all facets of formal and informal education, while the socio-cultural area included all aspects of the culture and society in which a child lived. Personality included preferences in learning styles, as well as differences in attribution patterns; that is, the factors to which females and males attribute success or failure such as "ability," "hard work," or "luck." Because I did not consider those attributes to be biologically based, I used the psychological term, *personality*, rather than the more value-laden terms *ability* and *aptitude*. My research focused on educational factors; and a decade of research and intervention projects revealed specific teaching behaviors and instructional techniques that encouraged females, as well as males to continue in science. Further-

1. **1983**
   Kahle
   Education Factors:
   Social, Cultural, Personality

2. **1985**
   Kelly
   Numbers, Package (Curriculum),
   Practice (Teaching Strategies),
   Biological

3. **1988**
   Eagly
   Social Role Theory
   "Sex differences are the product of social roles that regulate behavior in adult life." According to this theory, gender role expectations encourage conformity to specific roles or characteristices. Today, in general, roles & behaviors filled or held by men have higher status than those held by women.

4. **1989**
   Eccles
   - Environmental, not biological, factors are involved
   - Causal attribution patterns for success and failure
   - Input of socializers (teacher, parent)
   - Gender role stereotypes
   - Individual's own perception of various possible tasks

Figure 1. Factors Affecting Women in Science

more, I determined that, given appropriate conditions, those behaviors could be transferred to new groups of teachers.

Two studies, *Girls in School: Women in Science* (Kahle 1983) and *Project SCORES: Science Careers Options for Rural Environment Students* (Kahle 1987), identified factors which increased the interest levels, as well as the retention rates of females in science courses. The first one focused on determining which, if any, teaching strategies and teacher attitudes were successful in encouraging females to remain in science. The study combined qualitative and quantitative methods in order to assess the practices and behaviors of high school biology teachers in varying types of schools (rural, urban, suburban) and in diverse geographical regions. These teachers saw a high proportion of their female students to enroll in high school chemistry and physics and to enter college biology majors. The researchers found that the teachers used specific teaching practices; for example, compared to a national sample (Weiss 1978), they emphasized laboratory work and discussion groups; they quizzed their students weekly; they stressed creativity and basic skills; and they used numerous printed resources, rather than relying solely on one textbook. The teachers, mostly females, also provided their students with career information and with informal academic counseling. They all had attractive classrooms, decorated with posters and projects, and kept live plants and animals in their laboratories (Kahle 1983).

The qualitative and quantitative data gathered suggested that the specific teaching strategies and teacher behaviors listed above were important in retaining females in scientific studies. The study also showed that rural, compared with urban and suburban, high school students had fewer opportunities to work with the materials of science (both in and out of the classroom) and to experience science-related field trips as well as less access to role models and to career information. Therefore, the subsequent project, SCORES, focused on rural youth in biology classes taught by male teachers. We designed a field experiment that would allow students in rural high schools to have access to career information, contact with female role models in science, experience with a variety of science activities and field trips, and access to laboratory exercises that included two- and three-dimensional representations hypothesized to develop spatial skills (Kahle 1987). In addition, the research examined the efficacy of

transferring the behaviors, identified in the first study, to a new group of teachers. Basically, two research questions were asked: (1) What types of materials are more effective in increasing the interest level and the retention rate of females in science? and (2) Can teaching behaviors and attitudes, shown to be effective for females, be transferred to other teachers?

The project included two types of intervention conditions, "limited" intervention (teachers requested activities and materials) and "full" intervention (researchers provided materials and assistance at regular intervals). In addition, an equivalent school, teacher, and students served as a control setting. Qualitative and quantitative data were collected from the three sites. The teachers were observed for one semester. Demographic data were collected prior to the treatment; and, at the conclusion of the intervention program, questionnaires assessed any changes in students' perceptions of, attitudes about, or aspirations in science. In addition, enrollment data as well as achievement scores (final examination and final grades in biology) were collected. Lastly, all students in all three settings were asked to "Draw-a-Scientist" (Mead & Metreaux 1957).

After the intervention period, males, compared with females in all three groups, expressed more confidence in their scientific ability and had more extracurricular science experiences. Females in all groups revealed more positive attitudes toward women in science than did males. Overall student responses to the attitude, interest, and aspiration questionnaires closely reflected the grades received, with more positive responses found among students in the control classes: 65% of whom received *A* or *B* grades, compared with 47% of limited intervention and 38% of full intervention students.

Observers also noted differences in the teaching styles, knowledge of biology, and attitudes toward equity issues among teachers in the three groups. For example, the teacher in the control school stressed the use of algorithms and finding the correct answer, while teachers in the intervention schools placed more emphasis on using a problem-solving approach to determine answers. Observers noted that the teacher of the control classes appeared uncomfortable when they were in his classroom; often, he would comment about his wish to look good for the observers. In contrast, the intervention teachers proceeded with their lessons, ignoring the presence of the observers.

At the conclusion of the intervention program, students were asked to "Draw-a-Scientist" and to select their courses for the following year. In contrast to the attitudes and aspiration results from the questionnaires, these responses indicated positive results. Over 10% of the males in the full intervention school drew female scientists, while over 35% of females in the limited and full intervention school drew females. This large number of drawings of female scientists has not been found in other studies (Chambers 1983; Kahle 1989; Mason, Gardner, & Kahle 1991; Schibeci 1986). Furthermore, projected enrollment plans also suggested an impact of the project. Over 90% of the females in both intervention programs planned to enroll in chemistry, an optional science class elected by only 48% of the control school females and by 40% of high school females nationally. The project had affected the females' retention rate in science, but it had neither changed their negative attitudes nor raised their achievement levels.

There are two ways to explain the results obtained from SCORES' sustained intervention program. One is based on social desirability theory, and the other is founded in gender research. According to social desirability theory, the positive responses of students in the control school reflect both the more liberal grading policy of the teacher, as well as the students' desire to help their teacher. Although the research team was deliberately vague about the purpose of the project in order to avoid response bias due to the social desirability phenomenon (Turner & Martin 1984), the control teacher's anxiety coupled with his students' loyalty may have contributed to a response bias among the control students.

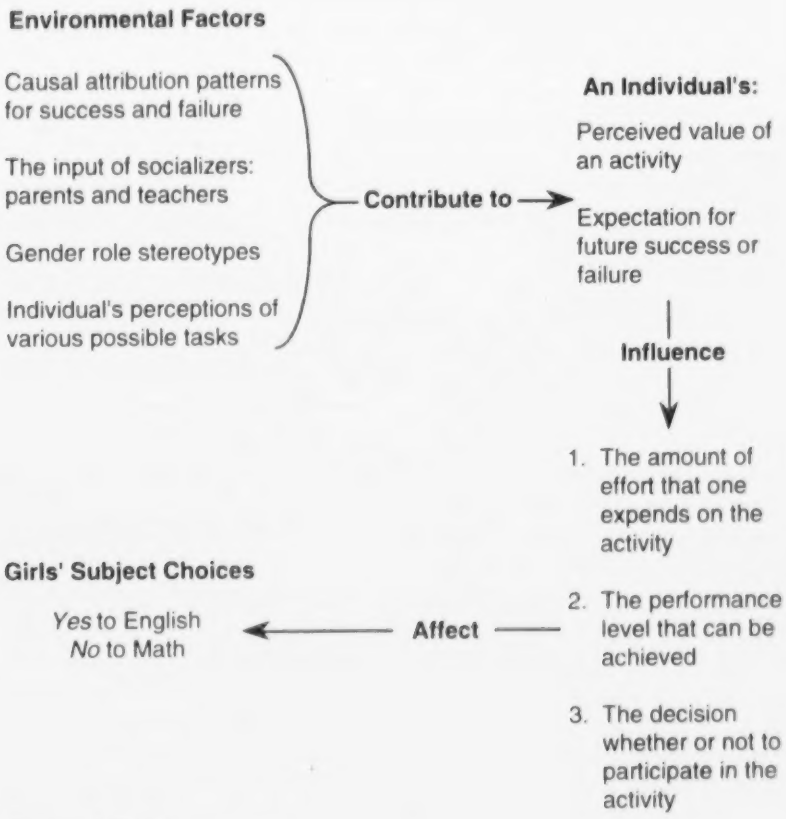
However, studies concerning gender differences in science offer a more direct explanation for the lack of attitudinal and aspirational change among females. The project was patterned after the Girls Into Science and Technology (GIST) project conducted in eleven schools in Manchester, U.K. The project was based on career information and designed around the expressed interest of females in certain topics (Kelly, Whyte, & Small 1984). Children's progress was followed for three years, prior to their making subject choices in upper secondary school (Whyte 1986). Analyses suggested promising instructional and curricular practices. However, results were mixed and inconclusive across the various schools. Neither GIST's nor SCORES' indirect, interest-oriented approach produced significant attitudinal or achievement changes.

Partly as a result of the GIST project, Alison Kelly, one of the principal investigators, suggested that an overriding factor affecting females' decisions to study and to participate in science was the masculine image of science (Kelly 1985). Her thesis was that science as an intellectual domain is perceived as masculine; and that perception discourages females from expressing interest in science, from achieving well in science, and from continuing to study science. As shown in Figure 1, she noted three ways in which science is perceived as masculine. They included the numbers who practice and who are rewarded in science; the way in which science is packaged in curricular and instructional materials; and the way in which science is practiced in schools, including student-teacher and student-student interactions. Although Kelly mentioned that the masculinity of science might have a biological basis, she concluded that there was inconclusive evidence for one. Instead, she described how the overwhelming number of men who both do and teach science combines with the way science is packaged and practiced to produce a masculine image. That image, she argued, is reproduced in schools where females are discouraged from active participation in science. All three of Kelly's factors are environmental in origin, and many subsequent intervention projects have focused on changing the practice and packaging of science in order to affect the numbers who do and teach science.

Although Kelly and I have based our studies in education, researchers in psychology have investigated gender differences as well. For example, Eagly (1987) hypothesizes that sex differences are the product of social roles that regulate behavior in adult life (note box 3 in Figure 1). According to social-role theory, gender differences in math and science are attributable to different gender-role expectations which encourage conformity to specific roles and behaviors. Females and males differ in their attitudes about and interest in science and mathematics, because they accept different gender-role expectations.

Eccles' work (1989) is based on psychosocial theory, also. As a result of a large study, involving thousands of Mid-Western females and their parents, Eccles has concluded that environmental, not biological, factors are responsible for the different achievement and interest levels in math of females and males. She delineates four types of environmental factors: first, casual attribution patterns for success

and failure; second, the input of socializers; third, gender-role stereotypes; and fourth, individual perceptions of various possible tasks. The interaction and effect of those four factors on females' subject choices is diagrammed in Figure 2. Eccles argued that, unless positive intervention occurs, the combined effect of those four types of factors leads inevitably to lowered interest and achievement levels in math and science for females, compared to males. For example, all four factors affect a child's perceived value of an activity. If an activity involves


Environmental Factors
Causal attribution patterns for success and failure
The input of socializers: parents and teachers
Gender role stereotypes
Individual's perceptions of various possible tasks
Contribute to
An Individual's:
Perceived value of an activity
Expectation for future success or failure
Influence
1. The amount of effort that one expends on the activity
2. The performance level that can be achieved
3. The decision whether or not to participate in the activity
Affect
Girls' Subject Choices
Yes to English
No to Math

Source: J. Eccles

Figure 2. Subject Choice

math or science, females tend to undervalue it. In addition, the four factors affect a child's expectation for future success. Females' as opposed to males' expectations for success in math and science decline as they progress through school. That decline occurs in spite of the fact that females' grades do not show a similar demise. According to Eccles, both one's perceived value of an activity and one's expectation for success in it influence the amount of effort one expends on the activity, the performance level that can be achieved, and the decision to participate in, or to continue, the activity. Eccles has found that when asked to choose between advanced math and English courses, significantly more high school females, compared to males, select English regardless of their academic grades in the two subjects. As Eccles (1989) states,

> As was true with confidence in their abilities, the females showed a linear decrease over age in their assessment of the value of mathematics. This pattern was not evident in the male population as the males moved through these secondary school years. The confidence pattern was further paralleled by a growing discrepancy between the value that the females attached to mathematics and English. Again, in contrast, the males, responses were about equal for the two subjects. As the females moved through high school, they reported valuing English increasingly more than they valued mathematics. (p. 43)

More recently, researchers have looked at changes in females' levels of self-confidence as they mature. Gilligan and others have shown that, in general, females' levels of self-confidence decline in adolescence (Prose 1990). The recent American Association of University Women study (AAUW 1990) demonstrates that females' self-confidence in science and math drops precipitously in adolescence. Females' decline in confidence in science and math is exacerbated by the masculine images of both subjects so that many females devalue those subjects during the critical early adolescent years.

A combination of practical and theoretical studies, therefore, has elucidated factors affecting females' choice of technical subjects and has proposed a theoretical basis for further work. For example, what can teachers (socializers) do to affect females' attribution patterns, particularly in mathematics and science, or how do teachers change sex-role stereotypes?

Concomitant with the gender research described above, Tobin and his colleagues in Australia were investigating interaction patterns in secondary science classrooms. They found that most science instruction involves whole-class activities; and during those sessions certain students, called target students, interact more frequently with the teacher (Tobin 1987; Tobin & Gallagher 1987). Briefly, there are two types of target students: (1) those who are more able and (2) those who are high risk takers. Tobin argued that knowledge is transmitted by teachers to target students and through them to the class as a whole. This is done by teachers addressing most questions to target students, by target students volunteering more frequently, and by teachers elaborating on target student responses more frequently and at greater length than they do for other students. He maintains that most students, therefore, develop understandings in a relatively covert way. The prevalence of target students in science classrooms is tied to a reward structure that encourages competition, rather than one that emphasizes learning. In co-educational classrooms, male to female ratios of target students are 4:1. However, Tobin and his colleagues have found that both types of target students are present in female schools and that their effect on classroom interactions is similar to that found in co-educational situations. In all educational settings, the presence and use of target students disadvantages many learners. For example, lower level cognitive questions are directed to as many as two-thirds of the class, while almost all higher level questions are directed to a few target students. Furthermore, in grades 9-12, target students tend to be constant year after year.

Tobin's work led me to investigate gender differences in teacher-student, student-student, and student-teacher interaction patterns. With four colleagues, I undertook a ten-week observation of two Australian teachers, Peter and Sandra, (Tobin, Kahle, & Fraser 1990), during which each of us focused on a different aspect of teaching and learning. I studied interaction patterns in order to assess any gender differences.

The results suggested that Peter held firm, sex-role stereotyped beliefs about the appropriateness of science for females and males. In his classroom, he called on females more frequently than he did males, but he asked higher-order cognitive questions almost exclusively of males. Although he rewarded females with more attention, his focus was on their personal, rather than their intellectual, traits. Peter

insisted that he favored females in his teaching, and outwardly he did. He assigned them, on the average, higher grades; he called on females more frequently than he did males; and he named equal numbers of males and females, when asked to identify bright students. However, the message was clear in Peter's class that success in science was unusual for a girl and usual for a boy. Therefore, in spite of receiving his attention and appreciation, few females, compared to males, continued to study science.

Sandra, on the other hand, served as a role model for the females in her class. She was both knowledgeable and concerned about equity issues. Yet, as a management strategy, she used many male target students, and male student-student interactions frequently disrupted the classroom and deleteriously affected all students' learning. Furthermore, in order to control disruptive males, Sandra adjusted seating arrangements and laboratory groups in ways that disadvantaged females. Only by long and careful analysis of Sandra's class were the subtle gender differences apparent. Although Sandra was able to encourage many females to continue to study science, their learning within her class was affected by many high-risk male target students (Kahle 1990).

The Australian study revealed much about the influence of teachers as socializers on females in science. For example, in our study Sandra carefully read and discussed all of our field notes, while Peter ignored them. As a consequence, Sandra became an active member of the research team. She often offered explanations for a particular interaction or activity, and she reflected upon the findings and instigated change in her teaching. The Australian study supports the psychosocial theory of gender differences by demonstrating the effect that socializers have on students' interest and continuation in science. In addition, it demonstrates the efficacy of the teacher as researcher model for changing teacher behaviors. That model, then, became the focus of the next study, *Science Education for Rural Girls: Educational Equity Through Master Teaching.*

In that project, teachers were solicited to participate and were introduced to the idea of teachers as researchers through a two-day interactive symposium with internationally-known researchers as well as with teachers who had previously been part of research teams. Then, during a week-long summer workshop, the teachers identified research topics that they could explore in their own classrooms with

the aid of the research team. The teachers read articles and completed laboratory exercises which stressed various teaching strategies, such as cooperative learning, developing student spatial and quantitative skills, and improving teacher-student questioning skills. Finally because their experience suggested that genetics was typically more difficult for females than it was for males, an instructional unit in genetics was developed by the teachers and the research team. It included many strategies that earlier research had identified as possible sources of gender differences in interest and retention in science. For example, activities were included that provided maximum hands-on experiences with the materials and equipment of science; and they were programmed in ways to foster cooperative, not competitive, learning. Each teacher was free to use any or all of the activities, following the limited intervention model of Project SCORES. In addition, monthly meetings were held and the teachers were financially supported to attend professional meetings, to report on the current study, and to write proposals for grants to support further work. In short, some teachers became researchers, assessing the effects of their instruction on their students, reporting their findings, and planning further studies. Other teachers participated minimally in the project, using few of the materials designed to augment skill development and to foster equitable classroom environments.

Independent observers were used to assess change in teaching behaviors and instructional techniques. Data included classroom observations, teacher and student questionnaires, and teacher ranking on an equity scale (Danzl-Tauer 1990). In addition, a teacher equity summary score was developed, based on any gender differences found on student responses in three areas: attitudes, achievement, and future enrollment in science. Although only teachers who chose to collect the relevant data could be compared, the equity summary scores, shown in the following table, indicated differences among the teachers. Those differences were supported by the independent observations. This study reinforced the effect of socializers on females' decisions about science, and it demonstrated the efficacy of the teacher as researcher model for changing gender-role stereotypes. It also added a new dimension to the paradigm for gender research: that is, the importance of skill development to change an individual's expectation for future success or failures.

Assignment of Teacher Equity Summary Scores

Teacher	Attitudes	Achievement	Enrollment	Total
A	0	1	1	2
B	0	1	1	2
C	1	1	1	3
D	0	1	0	1
E	0	1	1	2
F3	0	0	1	1

Note: Scores of zero indicate differences in scores between male and female students. Scores of one indicate no differences between male and female students. "Attitudes" reflect the Science Attitudes Questionnaire subscale. "Achievement" reflects the Difference Scores on the Genetics Achievement Tests. "Enrollment" reflects enrollment patterns in advanced science and mathematics courses.

Source: Danzl-Tauer, 1991

Another part of Eccles' theory concerns females' perceptions of various possible tasks, and the importance of self-perception of ability has been demonstrated by a study by Licht and her colleagues (Licht, Stader, & Swenson 1989). They found that females may begin a lesson or activity with lower expectations for success than males do, although the girl's lower expectations are unrealistic in light of their actual performances. All of the fifth graders in Licht *et al.'s* study were asked to indicate their perceived level of smartness in four subjects. Both males and females ranked their smartness in subjects in the following order: math, reading, social studies, and science. There was no difference in the self-perceptions of males and females in math and reading, but significant differences were found between males' and females' self-perceptions of smartness in social studies ($p < .025$) and

science ($p < .01$). Licht and her colleagues attribute at least part of that difference to the type of feedback received. The researchers found that teachers often graded more homework and daily assignments in math and reading than they did in science. Furthermore, grading in math and reading, contrasted with scoring in science, was annotated with explanations of errors and corrections. In science, many papers merely received a "checkmark" or an "OK." Generally, males reported receiving more overall feedback than did females ($M = 2.76$ vs. 2.38). Because females more often than males attribute failure in a task to low ability, the lack of, or ambiguity in, feedback differentially affected females.

Summary

Although various intervention programs have enhanced females' attitudes and interest in science, they have not eradicated achievement differences between males and females, nor have they substantively increased the retention rates of females and women in science courses and careers. Early work, which focused on educational factors and the masculine image of science, clearly showed that environmental, not biological, factors were involved in the observed differences in interest, achievement, and persistence of females and males in science. Eccles expanded on that work by articulating a theoretical construct to guide further study. Her psychosocial theory provided the basis of a paradigm to guide gender-based research. Other research has expanded the paradigm to include important new components, such as skill development, and to provide corroboration of the effects of identified components such as the role of socializers and the effect of gender-role stereotypes. As with all paradigms, the one proposed for gender-based differences in science provides a basis for further research. In addition, it provides information that enables us to more effectively design intervention projects.

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8

Effective Programming for Limited English Proficient Students

Sheryl L. Santos

As one travels abroad from the United States, one expects to encounter peoples of varying physical characteristics, linguistic expression, cultural values, modes of dress, culinary tastes and traditions. Ironically, one does not have to travel abroad to experience cultural diversity. A brief trip through any American city should suffice to create an awareness that the United States is a microcosm of the world.

As economic, political, and environmental disasters take their toll worldwide, continued immigration is expected. For example, it is likely that in the decade of the 1990s we will witness demographic changes in our schools as people flee the legacies of the war in the Middle East: squalor, devastation, and hopelessness. The Bush administration already announced on February 22, 1991, the creation of a new category of refugees who will be permitted to stay for another year in the United States under temporary protected status. As many as 51,000 persons who fled wars in Lebanon, Liberia, and Kuwait are among the first to qualify for this status. ("U.S. allows 51,000 war refugees" 1991). The 1970s and 1980s saw great numbers of Southeast Asians, Central and South Americans, and Europeans arrive to our shores. Between 1970 and 1979, 6.6 million immigrants were legally admitted to the United States (National Coalition of Advocates for Students 1988). Net civilian immigration between 1980 and 1988 exceeded 6 million, plus an additional 2 million or so undocumented persons (U.S. Bureau of the Census 1988).

Who are Limited English Proficient Students?

Limited English Proficient (LEP) students are those for whom English as a vehicle of instruction has not yet been mastered. Enrollment figures for 1988 indicated that 5% of the total school age population

in the United States, or approximately 2 million students, were classified as LEP (U.S. Department of Education [DOE] 1990). Some estimates of the student population have been recorded as hovering between 3.5 and 5 million students (Macias 1989), with much variation in home languages. Presently, more than 60% of LEP students are from Spanish speaking national origin groups, and over 30% of federally funded programs serve many different language groups including speakers of Native American languages, Southeast Asian languages, Asian languages, Arabic, Tagalog, Urdu, and others (Schmidt 1991). LEP students are usually foreign-born. However, there are many American-born students from non-English language background (NELB) homes for whom English is not the mother tongue. Many language minority students live in isolation from their English speaking peers in ethnic enclaves within the United States and do not use English for either social or academic purposes. For these students, attending a traditional Anglocentric American classroom is akin to a visit to a foreign country; even the food in the lunchroom seems strange. Unfortunately for many, it can turn out to be a traumatic and oppressive experience for them if the schools' educational personnel lack cultural awareness, sensitivity, and pedagogical skill. In *Indian Education from a Tribal Perspective: A Survey of American Indian Tribal Leaders,* Well, Jr. found that most Native Americans, "attend schools which are underfunded, controlled by non-Indians, staffed predominantly by Anglo teachers, and evidence little Native American content in the curriculum" (West 1991, p. 11).

Clearly, creating an effective, hospitable learning environment for students with limited English proficiency is a national challenge for the twenty-first century. The pressure is on all of us to dialogue, share, and disseminate to all preservice and inservice teachers, administrators, counselors, diagnosticians, and others information which will empower and awaken students to achieve their full potential.

Where do Students Reside?

Traditional ports of entry, such as New York, Texas, and California, are now being joined by others, such as Fall River, Massachusetts, as job markets shift and resettlement takes place. Fifty-five school districts

recently receiving the impact of new enrollees became eligible for a special grant award competition in 1989 sponsored by Office of Bilingual Education and Minority Language Affairs to meet the unexpected influx (DOE 1990). Even districts with declining enrollments are showing an upsurge of LEP students as well as are smaller districts previously unaffected by changing demographics (DOE 1990).

Figure 1 depicts the major United States cities where LEP populations reside categorized by those with less than 3% LEP student population; between 3 and 8%; and over 8%. States with the largest percentages include Arizona, California, Colorado, Connecticut, Florida, Massachusetts, New Mexico, New Jersey, New York, Rhode Island, Texas, and Utah. In California, 25.8% (7.7 million) of the population is Latino; this represents an increase of 70% since the 1980 census ("California's Hispanic population" 1991).

Historical Perspectives

Is America Prepared for the Challenge? Deeply ingrained in America's national character are inequalities related to ethnicity, class, gender, and language. Williams and Morland (1976) in their work on the historical foundations of racism in America, explore the consequences of slavery, segregation, scientific views concerning race, the effects of literary stereotypes, and state and federal legislative efforts to maintain a racially separate and unequal caste system. Broken treaties with Native Americans, the expatriation of Mexicans in the Southwest, and pervasive assimilation, which pressures non-European national origin people to "exorcise" themselves as quickly as possible of their mother tongues and any other telltale signs of cultural identity, have scarred America's reputation with a "color complex."

However, in all fairness, xenophobia is not an exclusively American phenomenon. In the eloquent words of Raymond Hall (1990, p.29) in *Refugees*, published by the United Nations High Commissioner for Refugees:

> Persecution and prejudice are as old as history itself, a stark demonstration of man's inhumanity to man. In the contemporary world, they are a major cause of refugee movements. The number of refugees throughout the globe acts, in a very real sense, as a barometer of human intolerance. A current

reading of that barometer gives no cause for complacency. From seven million refugees in the world in the late 1970s, numbers have risen inexorably towards the 15 million mark.

Certainly, many thousands of enlightened souls in this nation have actively sought progressive ways of uplifting humanity through lifelong efforts to ensure human and civil rights for all. With dignity and hope, many offered and lost their lives. But, the wounds of a violent past remain with us. The genocide committed against Native American and African peoples in America, are two examples of state-sanctioned violence which cannot be erased solely by dollars or legislative efforts. Since the 1954 Supreme Court Decision, *Brown v. Topeka Board of Education,* for example, the consequences of court-ordered busing with no provisions for a multicultural curriculum of inclusion in desegregated schools created a series of new problems and litigations.

Now, we must ask ourselves, if the education community has not even honestly or adequately addressed historical discrimination and its consequences, economic and political oppression, in relation to African Americans, Native Americans, Chicanos, Puerto Ricans, and others of its own culturally diverse citizenry, how well will this same educational system mobilize itself to provide access, equity, and excellence for recently arrived multilingual and multicultural populations who do not even have the power of the ballot?

Legislative Initiatives. Title VI of the Civil Rights Act of 1964 assures that students of a particular ethnicity, color, or national origin are not denied the opportunity to obtain the education generally obtained by other students in the system. In 1968, the Bilingual Education Act was passed during Lyndon B. Johnson's administration. However, it took a "Memorandum" from the Department of Health, Education, and Welfare (HEW) in 1970 in addition to the 1974 Supreme Court Decision, *Lau v. Nichols,* to ensure that students would be given an opportunity to successfully progress through the educational system while they are learning English. It was not until the *Lau* decision, followed by a second HEW Memorandum in 1975, that school districts realized that noncompliance with federal law could result in their losing all federal monies.

Between 1968 and 1991, language groups have had to struggle continuously to ensure that their constitutional and legal rights would be upheld. Even in New York City, a city with a very large Puerto Rican population, adherence to the Bilingual Education Act was not mandated until an agreement between the Board of Education and Aspira Inc. of New York, an advocacy group, averted a no-win court case by offering bilingual education to Spanish speaking language students as a result of the 1974 Aspira Consent Decree (Center for Law and Education 1975). And in the 1980s, the Reagan administration, characterized by its unrelenting efforts to undermine bilingual education programs despite the documented need (Crawford 1989), was challenged by the National Association for Bilingual Education to preserve the integrity of the intent of the law. Programs were weakened as a result of the laxity with which post-Lau decision guidelines were interpreted and implemented as well as due to inadequate funding for programs utilizing native languages as instructional tools (Ochoa & Caballero-Allen 1988).

Theoretical Frameworks

By studying the effects of programs that seek to assimilate students into the English language and White cultural norms without regard for the cultural identity that the student possesses, researchers discovered the negative academic and psychological effects of subtractive bilingualism, a process by which a student becomes a limited bilingual (Duncan & DeAvila 1979).

Subtractive bilingulism occurs when students do not have adequate opportunity to develop the literacy skills in either language needed to succeed academically. Consequently, their bilingualism hinders their chances to compete with native English speakers. The work of researchers such as Cummins (1979; 1981; 1986) has contributed to the development of the contextual interaction theory which suggests that academic success for language students cannot be achieved in a cultural vacuum (California State Department of Education [CSDE] 1982). Success is achieved as a result of the interaction of community background factors, student input factors, and instructional treatments. Affective and cognitive outcomes result from input factors such as fiscal resources, staff knowledge, skills, experience,

expectations, attitudes, and underlying educational assumptions or theories.

This theoretical framework differs from previous theories which tried to explain away students' difficulties in school in terms of their "cultural deficits" or language mismatch. Programs reflecting the cultural deficit theory convey a message to students that there is something inherently inferior about their own language and culture (Trueba 1987). The language mismatch theory results in programs which have as their underlying philosophy the belief that if students can only overcome their language "handicap" they will be able to compete on equal footing with native speakers of English. The contextual interaction theoretical framework, on the other hand, takes into account the importance of self-concept, empowerment, and self-determination for language communities; and expands the paradigm of what constitutes effective schooling by focusing on factors that affect school climate and its effects on motivation and achievement.

Recent efforts to establish an official language in the United States cannot go unnoticed in the context of the political and social climate in which we live and work. Therefore, as we discuss theoretical frameworks for programs designed to empower language minority populations, let us consider the following point of view by linguists Cummins and Skutnabb-Kangas (1988, p.13):

> For a country, official monolingualism in the majority of cases means that *all the minorities are oppressed and their linguistic human rights are violated.*
>
> To me, monolingualism, both individual and societal, is not so much a linguistic phenomenon (even if it has to do with language). It is rather a question of a psychological state, backed up by political power. Monolingualism is a psychological island. It is an ideological cramp. It is an illness, a disease which should be eradicated as soon as possible, because it is dangerous for world peace. It is a reflection of *linguicism.*
>
> Linguicism is akin to other negative-isms: racism, classism, sexism, ageism. Linguicism can be defined as *ideologies and structures which are used to legitimate, effectuate, and reproduce an unequal division of power and resources (both material and non-material) between groups which are defined on the basis of language (on the basis of their mother tongues).*

Misguided Assumptions About Educational Programming. Many school districts have been attending to the unique educational needs of multilingual communities for decades, while others have had little

prior experience. Given the magnitude and rapidity of changing demographics in far too many places, a desire for expediency has prompted districts into haphazardly designing and implementing educational programs for speakers of other languages which are based on misguided assumptions from "the school of conventional wisdom" without thinking through their theoretical framework, nor taking into account the experience of the field of bilingual education for the past two decades. A few of these misguided conventional wisdoms are:

- Use of the native language as an instructional tool retards English acquisition;
- Native language literacy is unimportant;
- As soon as they learn to speak English, students will be able to compete in academics with native speakers.

On the surface, these conventional wisdoms may appear reasonable; but, when examined in light of the research (Hakuta & Gould 1986), operationalizing these assumptions can be detrimental to students' cognitive and psychological development.

Guiding Principles for Program Development. There are five important principles which enable us to better understand the inadequacy of the previously stated assumptions, and upon which a sound program for language students should be based according to scholars in the field (CSDE 1982). These are as follows:

1. Proficiency in both the native language and English contributes to academic achievement.
2. Language proficiency is the ability to use language for both academic and communicative tasks.
3. The development of native language skills for academic purposes forms the basis for language proficiency in English.
4. Second language acquisition is fostered by comprehensible input and a supportive affective environment.
5. Student outcomes are affected by the perceived status of students and the quality of interactions between students and teachers and among students themselves.

Therefore, educational opportunities which include reading instruction in the primary language as well as in cognitively demanding subjects, allows for adequate native language development as well as positive messages concerning the value of students' languages and cultures.

Features of Successful Programs

The literature suggests that program type, or the way a program is structured, does not really explain the success or failure of educational experiences for LEP students. According to a recently publicized research study (Ramirez 1991), bilingual program type, whether English immersion, early-exit, or late-exit, does not yield enough statistical difference in student gains to justify claiming one a raging success over other program types. Although it was noted that students still receiving high levels of native language instruction through the sixth grade "appeared to be gaining in math, English-language, and English-reading skills faster than the general student population. The group that was rapidly moved into receiving mostly English instruction appeared to be losing ground in these areas, compared with students in general" (Schmidt 1991). For this reason, researchers, already aware of the problems faced by LEP students, have preferred to study the specific characteristics of those programmatic elements that actually do make the difference between mediocrity and excellence (Wong-Fillmore, McLaughlin, Ammon, & Ammon 1985; Tikunoff, 1985).

What does the literature tell us about significant features of effective programming for students with limited English proficiency? Considering how vulnerable LEP students are to how they are perceived and valued by teachers, by their peers, and by others in positions of power and authority, it is not surprising that Lucas, Henze, and Donato (1990) found that one of the most contributory features of achievement at the secondary level is the valuing of students, languages, and cultures. This is put into practice by encouraging students to speak and develop their primary language, hiring bilingual teachers, offering coursework in the native language, treating students as individuals, and taking the time to learn something about their language and culture.

A three-year study by the Texas Education Agency reporting and analyzing data from 144 school districts also highlighted a strong primary language focus and use of Spanish language textbooks as indicators of effective practices (Texas Education Agency [TEA] 1990).

The contextual interaction theory is supported by several studies which show the relationship between the school's climate and positive

student outcomes. Carter and Chatfield (1986) noted in their study of three bilingual schools that what is really important is an emphasis on processes as opposed to structures. School climate in effective schools is enhanced by good morale, high expectations for everyone, academically demanding programs, and a rejection of the cultural deficit theory with its implied stereotypes.

Process was also mentioned in the Texas case studies (TEA 1990) as being important in terms of community and parental involvement, upgrading the skills of both bilingual and nonbilingual staff, and development and implementation of campus philosophies, as well as goals and expectations.

Other significant features of effective programming include instructional strategies such as cooperative learning, sheltered English, content-based ESL, and whole language. Classroom practices which promote interaction and collaboration among students and teachers alike are proving themselves most successful.

Cooperative learning allows students to pool their talents and skills in a noncompetitive environment which fosters mutual respect and sharing. By including instructional strategies which meet the unique needs of linguistically different learners, teachers maximize the potential of each student. Sheltered English, which tailors lessons to include more audiovisuals and manipulatives, coupled with a strong program in mathematics, science, and social studies, gives students a head start in academic areas while learning English. Similarly, the use of whole language teaching approaches, with their emphasis on integrating listening, speaking, reading, and writing into the curriculum, proved more effective than traditional teaching methods relying on phonics or memorization.

School districts with high percentages of grade retention and dropouts should examine the effects of their promotion policies and investigate the steps they are taking to ensure that families who are newcomers to their educational system receive information in their native languages about what is expected of them and their children. Retention in grade creates psychological problems and can cause students to withdraw psychologically, emotionally, and intellectually. Failure to consult with communities about curricular concerns and policies in their own language creates a perception on the part of LEP families that they are not welcomed as partners and that the school

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Figure 1. Urban LEP Concentrations

belongs to others, not to them. Utilizing translators and interpreters to ensure that all students and their families are reached, or having a home/school liaison person in the school district or at each particular school site are not luxuries, but rather crucial factors for success. Too often teachers themselves perceive that language-minority parents are uninterested in their children's education when, in reality, strong efforts to involve LEP families in the educational life of their children have not been made. False stereotypes, myths, and erroneous perceptions wreak havoc on a campus and create unnecessary communication barriers.

How does a school, which is interested in meeting the academic, social, emotional, and psychological needs of its linguistically and culturally diverse students and their families prepare its students to meet tomorrow? Regardless of the type of educational program available to students at any one site, every school should attempt to address the total school environment by paying careful attention to the following aspects of the school's life and its impact on students and their families. These elements include: the quality of human relations, the provision of role models, equitable assessment practices, the implementation of a multicultural curriculum of inclusion, in addition to practicing positive intercultural communication skills, ensuring equal access, and involving parents. (Refer to the Appendix for a checklist of ingredients for effective programming.)

Future Directions

In summary, I perceive that one's philosophy of education coupled with one's world view will no doubt be consistent with the opportunities one chooses to provide for the inclusion of linguistic and cultural groups into the heartbeat of the school's life and culture. If one believes that diversity is valuable and that no one should be pressured to shed his or her language or culture— but rather add to oneself, schools will be more like botanical gardens, in which many diverse and beautiful species of plant life flourish side by side . The leadership of such schools will consciously seek to provide: (1) institutionalized and structured opportunities for intercultural sharing; (2) a multicultural curriculum, which treats critical historical events from the perspectives

of the participants, rather than from the perspective of the victors; (3) a demonstrated valuing of the gift of languages and the potential benefits of bilingualism for everyone; and (4) a climate of warm acceptance and inclusionary practices.

As humanity stands on the threshold of a new century, it is an opportune historical moment to reflect upon where we have been, where we are, and where we wish to go as a linguistically and culturally pluralistic nation. Each of us has the responsibility to examine the consequences of how we act upon our own philosophy of life and education. Perhaps an authentic dialogue among peoples of differing ideologies, world views, backgrounds, and cultures is long overdue; but, in my opinion, our society can never really achieve its democratic ideals without encouraging reflection, critically examining how we relate to one another, and providing vehicles for open communication and resolution of conflict.

The world has entered a new stage of interglobal communications and interdependency. Can we truly survive as a species if we do not know how to speak to one other, respect each other's values, understand each other's choices for self-determination, and treat each other with the dignity each deserves? I believe that "school" is the most likely place to begin and to sustain the dialogue among the human family. The curriculum should be about "us," about how we can open our eyes to the beauty and spirit of all others. The most challenging question of all is: How can we, the educated and technologically advanced, are going to raise the consciousness of the masses and redirect our energies toward creating schools which foster human caring, survival of the species, equality, and opportunities for all in an ever increasing hostile world of dwindling natural resources?

Appendix

Checklist of Ingredients for Effective Programming for LEP Students

Human Relations

- Are parents and children made to feel welcome and treated as important members of their new school?
- Are there staff who can greet them in their own language?
- Are there adequate personnel who know something about the daily lives of the students and their families?

Role Models

- Do children see people like themselves, from their ethnic and linguistic groups, in positions of power and importance?
- Are the teaching staff, administrative staff, support staff themselves diversified?

Assessment Practices

- Are children who are learning English as a second language tested on the same measures as native speakers before having mastered English?
- Is there an opportunity to be tested in the content areas in the students' own languages?
- Are gifted LEP students recognized?
- Are LEP students overrepresented in special education classes?

Multicultural Curriculum of Inclusion

- Are teachers aware of the students' identities?
- Do teachers seek to encourage sharing of historical perspectives from students' life experiences?
- Are teachers making an effort to become versed in American history from African American, Chicano, Latino, American Indian, Asian American and others' perspectives?
- Are there sufficient library materials in other languages and about many cultures?
- Are children encouraged to speak their own languages and share information about their languages with others?
- Is content area instruction in math, science, and social studies available in the child's native language?

Parental Involvement

- Do parents receive letters and communications from school in their own language?
- Are parents encouraged to participate in enhancing the multicultural aspects of the curriculum?
- Are the school's policies explained to parents along with expectations for parental participation?
- Do teachers reach out to parents for their support for their curriculum and class activities?
- Are interpreters available for meetings with parents?

Intercultural Activities and School Climate

- Is there an "intercultural fair"? Arts fair? Music fair? Foods bazaar? Literary and poetry readings?

- Are structured activities provided to teach children to respect and appreciate each other?
- Are teachers trained to intervene if they detect racial slurs or abuse? Are teachers prepared to counteract discrimination?

Access and Equity

- Do LEP students have equal access to computers?... To science labs and equipment?
- ... To math manipulatives ? ... To counseling for the college track?
- Can students take textbooks home for studying?
- Can students purchase copies of texts to write in? (LEP students perform better when they can write the translations directly into their texts as lessons are being taught.)
- Is there a teacher available who can translate difficult materials?

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9

Criticalmathematics Education: Bringing Multiculturalism to the Mathematics Classroom

Marilyn Frankenstein

The Criticalmathematics Educator Definition

As mathematicians, criticalmathematics educators view the discipline:

- as one way of understanding and learning about the world; they do not view mathematics as a static, neutral, and determined body of knowledge; instead, they view it as knowledge that is constructed by humans;
- as one vehicle to eradicate the alienating Eurocentric model of knowledge widely taught in the schools, particularly this model's narrow view of what are considered mathematical ideas and who are capable of owning these ideas, and this model's historiography which excludes and distorts, marginalizes and trivializes the contributions of women and men from all the world's cultures to what is then considered "academic" mathematics;
- as an human enterprise in which understandings result from actions; in which process and product, theory and practice, description and analysis, and practical and abstract knowledge are "seamlessly" interconnected (Lave 1988, p. 154); and in which mathematics and other disciplines interact, as does knowledge with the contexts of social, economic, political, and cultural perspectives.

As teachers, criticalmathematics educators:

- listen well (as opposed to telling) and recognize and respect the intellectual activity of students, understanding that "the intellectual activity of those without power is always characterized as nonintellectual" (Freire & Macedo 1987, p. 122);
- maintain high expectations and demand a lot from their students, insisting that students take their own intellectual work seriously, and that they participate actively as "cointerrogators" (Powell 1990) in the learning process;
- are not merely "accidental presences" (Freire 1982) in the classroom,

but are active participants in the educational dialogue, participants capable of advancing the theoretical understanding of others as well as themselves, participants who can have a stronger understanding than their students (Youngman 1986);

- assume that minds do not exist separate from bodies, and that the bodies or material conditions, in which the potential and will to learn reside, are female as well as male and in a range of colors; that thought develops through interactions in the world and that people come from a variety of ethnic, cultural, and economic backgrounds; that people have made different life choices, based on personal situations and institutional constraints, and that people teach and learn from a corresponding number of perspectives;
- believe that "most cases of learning problems or low achievement in schools can be explained primarily on motivational grounds" (Ginsberg 1986, p. 185) and in relationship to social, economic, political, and cultural context, as opposed to in terms of a *lack of aptitude* or *cognitive deficit*;
- recognize the reality of mathematics "anxiety," but deal with it in a way that does not blame the victims, and that recognizes both the personal psychological aspects and the broader societal causes;
- recognize that everyone has mathematical ideas; criticalmathematics educators "work hard to understand the logic of other peoples, of other ways of thinking." (Fasheh 1988)

As concerned active citizens, criticalmathematics educators:

- have a relatively coherent set of commitments and assumptions from which they teach, including an awareness of the effects of, and interconnections among, racism, sexism, ageism, heterosexism, monopoly capitalism, imperialism, and other alienating totalitarian institutional structures and attitudes;
- believe that good intentions are not enough to define a criticalmathematics educator: criticalmathematics educators are actively anti-racist, anti-sexist, anti-all of the other alienating totalitarian institutional structures and attitudes, and they work with themselves, their mathematics classes, and their colleagues to uncover, name, and change those conditions;
- view that a major objective of all education is to shatter the myths about how society is structured, to develop the commitment to rebuild alienating structures and attitudes, and the personal and collective empowerment needed to accomplish that task;
- are open to debate about which curricula and which investigations best achieve our goals; there are varieties of criticalmathematics

educators; for example, feminist criticalmathematics educators are not in every respect identical with socialist criticalmathematics educators;

- maintain that "dehumanization, although a concrete historical fact, is *not* a given destiny, but the result of an unjust order" (Freire 1970, p. 28);
- are militants in the Freirean sense of the term, committed to justice and liberation: "militancy forces us to be more disciplined and to try harder to understand the reality that we, together with other militants, are trying to transform and recreate. We stand together alert against threats of all kinds" (Freire 1978, p. 146);
- understand that no definition is static or complete, all definitions are unfinished, since language grows and changes as the conditions of our social, economic, political, and cultural reality change;
- also have fun, laugh, and play... (Frankenstein, Powell, & Volmink 1991, p. 51)

The preceeding definition was constructed by myself, Arthur B. Powell, and John Volmink as part of our project to organize mathematics educators in order to work on connecting our concerns in mathematics education with our critique of society and our commitments to social, economic, political and cultural empowerment. It is patterned after the "radicalteacher" definition, constructed by Pamela Annas, which appears on the back cover of every issue of *Radical Teacher*. We write criticalmathematics as one word in order to symbolize our hope that one day *all* mathematics education will be critical. We defined educators rather than education in order to focus on the actors as opposed to the discipline and in order to recognize that the ways of realizing the goals of criticalmathematics education—the educational institutions, the curricula, and so forth—are much more varied and open to debate than the goals themselves.

My work as a criticalmathematics educator involves teaching criticalmathematics literacy at the College of Public and Community Service (University of Massachusetts/Boston). My students are mainly working class urban adults in their 30s, 40s, 50s, and older, who have not been tracked for college; many of them were labeled as failures in secondary school; and most have internalized negative self-images about their knowledge and ability in mathematics. Approximately 60% are women; 30% people of color. Most work (or are looking for work) full-time, have families, and attend school full-time. Most work

in a variety of public and community service jobs; many have been involved in organizations for social change. Students can work toward their degrees with credit for prior learning from work or community organizations or new learning in classes or new learning from work or community service. For example, students lobbied the legislature and organized for welfare rights forming the Massachusetts Coalition for Basic Human Needs; students, asked by the community, worked with faculty to serve as consultants for the Roxbury Technical Assistance Project to help that community participate in planning its own development. Faculty members are themselves activists, as well as intellectuals; approximately 50% are women, 30% people of color. Teachers have less institutional power over students than they do in most universities, because we do not give grades, and students can choose another faculty member to evaluate their work if they are dissatisfied with the first faculty evaluation. The faculty cannot require attendance or any other work that is not clearly discussed in the competency statement which details the criteria and standards for demonstrating knowledge of the topic which students are studying.

In this chapter, I will briefly discuss my criticalmathematics literacy curriculum and then focus on the aspects of that curriculum that are related to what is often labeled "multicultural" education.

The Criticalmathematics Literacy Curriculum

At a math conference on problem solving, the teacher illustrating Polya's (1957) ideas on problem solving by identifying analogous problems, stated that in the problem, "If three people take ten hours to dig a hole, how many hours would it take ten people to dig that same size hole?" It is obviously equivalent to whether people dig the hole or machines dig the hole. From a criticalmathematics perspective, whether people or machines dig holes involves crucial issues of concern to our society, issues such as automation, unemployment, and quality of life. To learn mathematical problem solving without engaging these issues is to become functionally, as opposed to critically, literate. Giroux's (1982) categorization of the instrumental ideology underlying so much of native-language literacy is helpful in understanding the nature of this kind of mathematics literacy. Instrumental

ideology views knowledge as objective and external to the knower. Facts are neutral, stripped of the subjectivity of class, ethnicity, and gender perspectives. Functional mathematics curricula, based on this ideology, strip mathematics of its relationship to the learner and to our society, concentrating instead on mechanical proficiency and rote memorization. These instrumental curricula are based on a fragmented view of mathematics knowledge, a view which omits the way statistical knowledge is often used to obscure economic and social realities. At its worst, this view of mathematical knowledge can result in the kind of blind pursuit of "neutral" knowledge which produces, for example, nuclear weapons without awareness or questioning of the interests and choices that direct this science. As Marcuse (1964) argued:

> In this society, the rational rather than the irrational becomes the most effective vehicle of mystification.... for example, the scientific approach to the vexing problem of mutual annihilation—the mathematics and calculations of kill and over-kill, the measurement of spreading or not-quite-so-spreading fallout....is mystifying to the extent to which it promotes (and even demands) behavior which accepts the insanity. It thus counteracts a truly rational behavior—namely, the refusal to go along, and the effort to do away with the conditions which produce the insanity. (pp. 189-90)

Criticalmathematics literacy, on the other hand, involves the ability to ask basic statistical questions in order to deepen one's appreciation of particular issues, along with the ability to present data to change people's perceptions of those issues. A critical understanding of numerical data prompts one to question "taken-for-granted" assumptions about how a society is structured, enabling us to act from a more informed position on societal structures and processes (Frankenstein & Powell 1989). The themes in my criticalmathematics literacy curriculum range from demystifying the structure of mathematics to using numerical data for demystifying the structure of society. Mathematics "anxiety" is analyzed in terms of misconceptions about learning mathematics (Frankenstein 1984); understanding mathematics is presented as an important aspect of reading comprehension in most disciplines; and mathematical data are used to illuminate political, economic, and social issues. The theory and practice of this curriculum are discussed in depth in Frankenstein (1987) and *Relearning Mathematics* (1989).

The themes in this curriculum that relate to what is often labeled "multicultural" education fall under three main categories. The first involves using numerical data to examine how ethnicity, gender, class, and other institutional structures work to disempower people. The second involves students' reflecting on mathematics education research pointing to ways of mathematically empowering people. The third involves challenging the effects of Eurocentrism and male-centrism on mathematical knowledge, a challenge which forces us to reconsider what counts as mathematical ideas and to revise the historiography of what is labeled "academic" mathematics.

The "Multicultural" Aspects of Criticalmathematics Literacy Critically Examining Ethnicity, Gender, and Class Issues

As an educator committed to changing alienating institutional structures, this curriculum reflects my belief that in order to work towards empowerment, we need to understand disempowerment. One of the problematic aspects of much "multicultural" education is its lack of attention to differential power. This is one main reason why the "anti-racist curriculum" movement in London does not use the term "multicultural" (Powell & Singh 1990). All cultures are not equal in our current situation. Malecentric, Eurocentric culture dominates us all, imposing its values, theories, and practices, with an emphasis on abstract, consistent justice over caring and connectedness (Gilligan 1982), to an insistence on the usage and "superiority" of "standard" English (Labov 1972). In order to overcome this cultural imperialism of the mind, it is important to analyze how various institutional structures support this alienation, making it seem natural, blaming the victims.

In the criticalmathematics literacy curriculum, I argue that understanding numerical data is a key aspect of understanding how racism, sexism, monopoly capitalism, and other structures disempower people (Frankenstein 1990). Students learn the meaning of numbers and basic math operations as they reflect on real data about these issues. The math problems are, within the constraints of covering the entire basic math curriculum, those that arise naturally from the situation as a way of more fully comprehending the issues. Many

exercises involve open-ended problem creating, in which students consider which ways of expressing the data are more powerful, and which ways are deceptive. The following examples from *Relearning Mathematics* (Frankenstein 1989) illustrate these aspects of the curriculum:

EXAMPLE 1: An exercise to practice the meaning of fractions:
Use the passage below to answer these questions:

(a) What is Helen Keller's main point?
(b) How do the numbers she uses support her point?
(c) Why does she sometimes use fractions and at other times use whole numbers?

"Although Helen Keller was blind and deaf, she fought with her spirit and her pen. When she became an active socialist, a newspaper wrote that "her mistakes spring out of the... limits of her development." This newspaper had treated her as a hero before she was openly socialist. In 1911, Helen Keller wrote to a suffragist in England: 'You ask for votes for women. What good can votes do when ten-elevenths of the land of Great Britain belongs to 200,000 people and only one-eleventh of the land belongs to the other 40,000,000 people? Have your men with their millions of votes freed themselves from this injustice?'" (Zinn 1980, p.337)

EXAMPLE 2: An exercise to practice comparing the size of numbers:
Discuss the comparisons it makes sense to consider to understand the following statement.

"The relationship of these global corporations with the poorer countries was an exploiting one, it was clear from US Department of Commerce figures. Whereas US Corporations in Europe between 1950 and 1965 invested $8.1 billion and made $5.5 billion in profits, in Latin America they invested $3.8 billion and made $11.3 billion in profits, and in Africa they invested $5.2 billion and made $ 3 billion in profits." (Zinn 1980, p.557)

EXAMPLE 3: An exercise to practice subtraction:
Read the following excerpt from a pamphlet written by supporters of the incorporation of Mandela as a city in Massachusetts.

(a) Discuss the key numerical arguments. Do you agree or disagree? Why?
(b) Create and solve two math problems using the information about Mandela whose solution involves subtraction.

QUESTIONS AND ANSWERS ABOUT MANDELA

Where is Mandela?

Mandela is Greater Roxbury. It covers about 7,600 acres or 12.5 square miles. Its north boundary is in the South End; the south boundary is at the

Mattapan/Milton town line; the east border includes parts of Dorchester, roughly even with Dorchester Ave.; the west boundaries are in Jamaica Plain and the Fenway. It also includes Columbia Point. The wards involved are all of Wards 8, 9, 11, 12, and 14, plus parts of Wards 4, 10, 13, 15, 17, 18, and 19.

Mandela includes a number of residential communities and commercial districts. It also includes several major institutions, such as Roxbury Community College, Northeastern University, University of Massachusetts—Harbor Campus, several public schools, The National Center for Afro-American Artists, the Museum of Fine Arts, several community health centers, Boston State Hospital, the Chronic Diseases Center, several MBTA stations, fire and police stations, as well as numerous social service and community development agencies.

Who lives there?

The population of Mandela is about 150,000, enough to be the fourth largest city in the state. The population represents a number of racial and ethnic groups: three quarters (74%) are Blacks, including Afro-Americans, people of Caribbean descent, and peoples from continental Africa. One in ten are Hispanics, representing Puerto Rico, Mexico, and Cuba as well as other Latin American countries. The remaining 16% come from a number of groups, including Whites and Asian-Americans. Mandela's population is young, with a majority of its population between 20 and 34 years of age.

What can incorporation mean for Greater Roxbury?

Independence will mean that we can have a decision making role in how public lands are disposed of- instead of the advisory role we have now with the downtown government. We would be able to decide how public lands are divided between different uses such as health care, child care, parks, etc. We would have people from our own community making decisions that affect our day-to-day lives, keeping our interests from "getting lost in the sauce" of other communities' interests. Having our own people in the leadership of an independent city that works would build community pride and would create role models for our young people—showing them that we can! It would also give new meaning to the efforts of each and every citizen to make city government work for the community.

Would the Mandela city government have enough money to pay for the necessary city services?

YES! In 1986, the city of Boston estimated that if Mandela was a separate municipality (city) there would be $350 million in revenues. However, city officials also said that we would need $450 million to pay for the needed services. We disagree with the City's estimates of expenses. Given our population, we believe that $350 million would be more than enough to pay

for the costs of running an effective city government. For example, the city of Springfield covered its expenses with just over $230 million in fiscal year 1988, and its population is upwards of 170,000. Worcester, with a population of over 170,000 had just over $226 million that year. We are confident that Mandela could support itself. One of the reasons we disagree is that no city stands alone in paying for its services. In Springfield, for example, 26% of revenues were raised through taxes, 9% through local receipts (including fees and fines), 54% from state aid, and the remaining 12% through "other" means including federal aid. The pattern is similar for other towns and cities in the Commonwealth. During fiscal year 1988, Boston received 37% of its revenues from state aid and 26% from sources other than taxes and local receipts (including federal aid). State aid is determined through a formula that takes into account population density, numbers of students, employment levels, age of the housing stock, poverty levels, and other indicators of need. Clearly, the city of Boston receives a good deal of assistance because of the large numbers of low income people in Mandela. The funds that the city of Boston receives from the state and federal governments on behalf of Mandela would go to Mandela's city government.

EXAMPLE 4: An exercise to practice general problem creating and solving: For each of the following facts, taken from "The Centralization of Capital" (Dowd 1978), perform some mathematics operations that further clarifies or strengthens the implications, and list additional statistics you would collect to strengthen the data even further:

(a) The assets of the top 500 industrial corporations in 1972 were $486 billion; of the second 500, about $46 billion. The assets of the top ten companies were $109 billion.

(b) The industrial corporation with the greatest assets is Exxon; in 1972 its assets were $21.5 billion. The company with the smallest assets of the top 500 in 1972 was Varian Associates, with $188 million. Exxon's sales in 1972 were $20 billion; Varian's were $203 million.

(c) The *profits* of the largest ten corporations (industrial and non-industrial)—AT&T, GM, Exxon, IBM, Texaco, Ford, Gulf Oil, Sears Roebuck, Mobil Oil and Standard Oil of California—were $10.3 billion *after* taxes in 1971. The two largest—AT&T and GM—made $2.2 billion and $1.9 billion, respectively. Total corporate profits in 1971 were just under $50 billion after taxes.

EXAMPLE 5: An exercise to practice general problem creating and solving: Create as many math problems as are suggested by "Terror Tally." (Kelly 1985) Solve them and discuss why they clarify or refute points made in the article.

Terror Tally

One of the mainline media's foulest formulas has been repeatedly applied in recent days. If the amount of ink spilt in the nation's foremost daily can be taken as a measurement, then it would seem a single American businessman's life is far more noteworthy than those of 72 Arab-American activists.

The apparent murder of Leon Klinghoffer aboard the Achille Lauro has been the subject of countless commentaries. Fine, but what about the 60 Palestinians and 12 Tunisians killed in the Oct. 1 Israeli air strike? The lives of foreigners, especially those in the third world, generally warrant only scant attention from the oh-so-balanced U.S. press. And members of unpopular minority groups in this country also do not evoke many media lamentations when they are murdered.

These comparisons can be quantified. On Oct. 12, the New York Times ran a 21-column-inch Klinghoffer profile, meanwhile devoting nine inches to the California bomb-slaying of Arab-American professor Alex Odeh, whose age was incorrectly reported in the UPI dispatch. Next day, the Times had two Klinghoffer pieces totaling 30 inches; Odeh's murder still rated only nine inches and perfunctory wireservice coverage. The Times has also not seen fit to mourn Odeh or to denounce his killers on its editorial pages. Even liberal conscience Tom Wicker let this attack go unremarked upon in a column on terrorism.

Media culpability does not end there. The day before he was blown up, Odeh was interviewed by Los Angeles's KABC-TV. In one part of the 35-minute segment that was broadcast, he called on the press to treat the PLO fairly. In a section that was edited out, Odeh deplored the ship hijacking and terrorism in general.

Critically Reflecting on "Multicultural" Mathematics Education Research

In spite of the disempowering effects of alienating institutional structures, criticalmathematics educators have been developing ways of working with people towards mathematical empowerment. Underlying much of that work is Paulo Freire's theory that liberatory education does not dichotomize the activity of teachers and students. In this view, people are not cognitive—only learning—at one point and then they "know it all," so at the next point they are narrative, owning the knowledge which as as teachers they stuff into the heads of students.

Rather, each of us constantly reforms our knowledge based on our own and others reflections. Students and teachers are "critical coinvestigators" in the process of learning-teaching (Freire 1970). Only by creating and re-creating the knowledge for themselves, can students truly understand the structure of mathematics and how that knowledge is an important part of understanding and recreating the world. Freire (1973) continues in a later work:

> Knowing, whatever its level, is not the act by which a subject transformed into an object docilely and passively accepts the contents others give or impose on him or her. Knowledge, on the contrary, necessitates the curious presence of subjects confronted with the world. It requires their transforming action on reality. It demands a constant searching. It implies invention and re-invention. It claims from each person a critical reflection on the very act of knowing. It must be a reflection which recognizes the knowing process, and in this recognition becomes aware of the *raison d'etre* behind the knowing and conditioning to which that process is subject. (p.101)

Further, nonliberatory education is such a powerful influence, that criticalmathematics education must be "self-consciously oppositionist" in order to avoid being co-opted and "subtly transformed into a means of increasing conformity to existing social institutions and arrangements" (Cagan 1978, p.244). In the criticalmathematics literacy curriculum, one way to strive for this goal is to break through the dichotomy between teaching and learning (Frankenstein 1991). At the same time that students are learning the basic math, they are reading and reflecting on excerpts from mathematics education research. This is one way in which they gain control over their own learning. The following excerpts involve issues of concern to a "multicultural" mathematics curriculum: the first because of its findings about why certain students could not do "academic" mathematics; the second because of its findings that *all* students come to school with the intellectual development to enable them to do "academic" mathematics; and, the third because of the dialogue it opens up about the advantages of math "anxiety" for the dominant society.

EXAMPLE 6: Students read excerpts from "Mathematics in the Streets and in Schools" (Carraher, Carraher, & Schliemann 1985), a research study conducted in Brasil that found "performance on mathematical problems embed-

ded in real-life contexts was superior to that on school-type word problems and context-free computational problems involving the same numbers and operations" (p. 21). The researchers analysis concludes that: "In the informal test, children rely upon mental calculations which are closely linked to the quantities that are being dealt with... In the formal test, where paper and pencil were used... the children try to follow, without success, school-prescribed routines. Mistakes often occur as a result of confusing [the algorithms]. Moreover, there is no evidence, once the numbers are written down, that the children try to relate the obtained results to the problem at hand in order to assess the adequacy of their answers. The results [of this study] support the thesis... that thinking sustained by daily human sense can be—in the same subject—at a higher level than thinking out of context." (p. 27)

By reflecting on math researchers' analyses of other students' difficulties with mathematics, my students begin to develop strategies for dealing with their own problems in learning mathematics. They reevaluate their own math problem solving techniques, making connections between their real-life knowledge and their performance on homework and tests. We discuss how they often hand in answers they know are wrong simply because they do not check to see if their answers made sense. Becoming aware of the seeming disjunction between their work in school and their use of math in their lives helps move students towards reconnecting their knowledge in those two arenas.

Example 7: Students read excerpts from "The Development of Addition in the Contexts of Culture, Social Class, and Race" (Ginsburg 1982), a study which concludes that: "...in the vast majority of cases, children of different social classes and races demonstrated similar basic competence on the various [mathematical] tasks and used similar strategies for solving them... These results suggest that although culture clearly influences certain aspects of cognition (e.g., linguistic style), other cognitive systems develop in a uniform and robust fashion, despite variation in environment or culture. Children in different social classes, both Black and White, develop similar cognitive abilities. The research suggests... that educators must take seriously the notion that upon entrance to school virtually all children possess many intellectual strengths on which education can build... without the benefits of schooling, young children already understand basic notions of mathematics.... If we fail to educate poor children, then it does not help to blame the victim by proposing poor children are cognitively deficient or genetically

inferior. We need instead to consider things like motivational factors linked to expectations of limited economic opportunities, inadequate educational practices, and bias on the part of teachers...." (pp. 207-9)

EXAMPLE 8: Students read excerpts from "Overcoming Math Anxiety by Learning about Learning" (Frankenstein 1984) in which I argue that much math "anxiety" stems from misconceptions about learning and in which I conclude with why I have always felt uncomfortable calling people math "anxious": "The effect of such a label is contradictory. On the one hand, students are initially relieved that their feelings about mathematics are so common that educators 'have a name for them.' On the other hand, the label can focus the problem inward, 'blaming the victims' and encouraging solutions directed solely at them (Apple 1979, p.135). The label can direct attention away from the broader social context of how these misconceptions about learning come to be so universally believed, and what purpose society's having large numbers of math 'anxious' women, for example, might serve... The political, economic and social structure of our society naturally produces math 'anxiety.'... having students explore these underlying causes is the most epistemologically sound way of turning their inward 'anxiety' into an outward constructive anger that will move them towards true mathematics accomplishment." (p. 177)

Reflecting on these speculations results in students broadening their focus to grapple with how and why they have internalized society's views of their mathematical abilities. This analysis encourages them to pry apart the structural limitations to their success and to act on the possibilities that exist to learn mathematics even within the current alienating societal context. Selections from two student journals that illustrate this follow:

I think I know part of the reason math is difficult for me. I seem to do math in a disorganized manner... while doing my homework I became conscious of the amount of scrap paper I used. The figures were all over the paper and at times I couldn't figure out what part of the problem I was working on and what I had figured out before.... I'm going to have to find a method of keeping things organized. (Anon.)

I can see now how important that is [to get everyone to participate in the class discussions... for everyone to help each other],... The fact that another student can answer the question that one presents is an encouragement... to put forth a little more effort because if another student can understand enough to answer, then you can understand. (Anon.)

Challenging the Effects of Eurocentrism and Malecentrism on Mathematical Knowledge—Critically Examining What Counts as Mathematical Ideas

My students are often surprised to learn that the decimal point is the same as the point used in writing amounts of money. One of the effects of the particular malecentric and Eurocentric perspective that has shaped "academic" mathematics is a fragmentation between "everyday" mathematics knowledge and "school" mathematics. This can then result in students' feeling that they do not understand any mathematics. Harris (1987) showed how this dichotomy intersects with sexism in considering what counts as mathematical knowledge. For example, an engineering problem about preventing the lagging in a right-angled cylindrical pipe from inappropriately bunching up and stretching out, is labeled "mathematics;" whereas the identical domestic problem of designing the heel of a sock is called "knitting" and not considered to have mathematical content. Joseph (1987) demonstrated how this split, combined with racism, results in academic mathematicians' narrow view of what is considered a "proof." Egyptian and Mesopotamian mathematics are dismissed as merely the "application of certain rules or procedures... [not] 'proofs' of results which have universal application" (pp. 22-23). Joseph disputed this definition arguing that:

> ...the word "proof" has different meanings, depending on its context and the state of development of the subject... To suggest that because existing documentary evidence does not exhibit the deductive axiomatic logical inference characteristic of much of modern mathematics, these cultures did not have a concept of proof, would be misleading. Generalizations about the area of a circle and the volume of a truncated pyramid are found in Egyptian mathematics... As Gillings (1972, pp.145-46) has argued, Egyptian "proofs are rigorous without being symbolic, so that typical values of a variable are used and generalization to any other value is immediate." (pp. 23-24)

In the criticalmathematics literacy curriculum, these Eurocentric and malecentric views of what counts as a mathematical idea are broadened to include all the different kinds of activities involving counting, ordering, sorting, measuring, inferring, classifying, and

modeling as they appear in all the world's cultures (Bishop 1988). These ideas are considered in ways that uncover their connections to the development of human societies. The following examples illustrate some ways in which I encourage students to appreciate that they know more mathematics than traditional evaluations reveal. The examples require that students analyze how they currently use mathematical ideas and how knowledge that they have labeled "nonmathematical" or "illogical" can be considered part of mathematical knowledge.

EXAMPLE 9: Students are asked to write about various activities in which they are involved—some aspect of housework, some aspect of their paid work, some aspect of their leisure interests. Then they are asked to review these situations carefully for all the uses of mathematics. Discussions bring out many examples where students did not realize they understood and used mathematical knowledge.

EXAMPLE 10: Students reflect on how a Mozambican teacher uses various aspects of traditional material Mozambican culture to reveal "hidden moments of geometrical thinking" (Gerdes 1988, p. 140). He illustrates how studying the geometry behind certain Mozambican baskets and fish-traps stimulates students to reconsider the value of their cultural heritage—"geometric thinking was not and is not alien to our culture"—and serves as a "starting point and source of inspiration for doing and elaborating other interesting mathematics" (pp. 153-60) such as tessellations, trigonometry and polyhedra. When his Mozambican students analyze the construction of a woven button, commonly used to fasten the top of a basket in Southern parts of Mozambique, they uncover the Pythagorean theorem. And they realize: "Had Pythagoras—or somebody else before him—not discovered this theorem, we would have discovered it!"... By not only making explicit the geometrical thinking culturally frozen in the square-woven buttons, but... by revealing its full potential, one stimulates the development of... culturalmathematical (self) confidence... The debate starts. "Could our ancestors have discovered the 'Theorem of Pythagoras'? 'Did they?'.... 'Why don't we know it?'.... 'Slavery, colonialism....' By 'defrosting frozen mathematical thinking' one stimulates a reflection on the impact of colonialism, on the historical and political dimensions of mathematics (education)." (pp. 151-52)

Reading about the mathematical ideas "frozen" in other cultures stimulates students to thaw out the mathematical ideas inherent in their own material activities.

Example 11: Students are asked for alternative explanations of a commonly repeated anecdote, originally told to illustrate how an African Demara sheep herder cannot comprehend that 2+2=4. It describes how the herder agrees to accept two sticks of tobacco for one sheep but becomes confused and upset when he is instead given four sticks for two sheep. My students come up with many answers from the fact that the trader broke the contract by switching to two sheep, to the mathematical analysis that, "Sheep are not standardized units. [The Demara herder's] confusion could be attributed to the trader's willingness to pay an equal amount for the second, different animal.... the applicability of even the simplest of mathematical models becomes a question of cultural categorization." (Ascher & Ascher 1986, p.128)

This discussion reveals how false assumptions about others' mathematical knowledge and lack of respect for others' logic intersects with Eurocentric racism in considering what counts as mathematical knowledge. This analysis can then be extended so that students gain greater appreciation of their own logic patterns, developing confidence and insights to help them search for the logic in their own mathematical problem solving.

Challenging the Effects of Eurocentrism and Malecentrism on Mathematical Knowledge—Critically Reflecting on the Hidden and Distorted History of Mathematics

Gerdes (1985) argued that cultural affirmation is one of the key factors in the struggle against the mathematical underdevelopment caused by racism, sexism, and imperialism. "For mathematics to become emancipatory, it is necessary to stimulate confidence in their [students'] capacities to understand, develop and use mathematics" (p. 17). Further, Ginsberg's (1986) cross-culture, -ethnicity, -class research in cognitive psychology supports his theory that, "It is not enough to say, as Piaget seems to, that the cognitive structures are the source of their own motivation...." (p. 185). He argues that many other forms of motivation are also important and speculates that:

...most cases of learning problems or low achievement in the schools can be explained primarily on motivational grounds rather than in terms of fundamental cognitive deficit. Most children fail in school not because they are

stupid (cognitively deficient, lacking in 'formal operations,' etc.) but because they are afraid, turned-off, and the like... understanding motivation may be at least as useful for educational practice... as knowledge of cognitive structure or process. (p.185)

The following examples are designed to increase motivation and self-confidence through the knowledge that all cultures have contributed to the history of mathematics and through analysis of how male-centric and Eurocentric perspectives have distorted and frozen this history.

EXAMPLE 12: Students reflect on a summary (Frankenstein & Powell, in press) from part of *Black Athena* (Bernal 1987, pp. 272-80) which provides details of how the constructed, Eurocentric dichotomy between everyday "practical" mathematics and formal "theoretical" mathematics was used to resolve the "tensions" around the discoveries of the mathematical knowledge embedded in the pyramids. Bernal (1987) provides fascinating detail of how this practical/theoretical split was used to resolve the "tensions" around the discoveries of the mathematical knowledge embedded in the structure of the pyramids. If the Greeks were the first "true" mathematicians, how could European scholars explain that such extraordinary mathematical precision, including measurements that lead to π, ø, and Pythagoras' triangle, had been built into the pyramids by the ancient African Egyptians (described by classical Greek scholar Herodotus as having "black skins and woolly hair"). Bernal, in his wonderful sarcasm, describes how this tension: "is made still more unbearable by the fact that the Greeks had been told about many of the Pyramids' extraordinary features and that they believed the Egyptians to have been the first mathematicians and astronomers. Finally, there is the problem that so many of the Greek mathematicians and astronomers had studied in Egypt." (p. 277)

Bernal (p. 278) further shows how the simplest resolution—"believe the Greeks and accept... that there was an... 'axial age' around 3000 B.C.," followed a few centuries later by a sophisticated knowledge of mathematics, built into the pyramids, retained by later Egyptians and passed on by them to visiting Greeks... was "not available to conventional scholars at the height of imperialism." The rejection of this simpler solution persisted in spite of the fact that there is nothing to back the alternative hypothesis—that the Greeks achieved a sudden, qualitative intellectual breakthrough in the 4th century BC—"approximating to the actual achievements of the Pyramids and the consistent ancient tradition of a superior Egyptian mathematics." The foundation supporting the alternative "Greek Hypothesis" was the argument that

the mathematical knowledge embedded in the Pyramids were "chance qualities that had remained totally unsuspected to the constructors," purely the result of "intuitive and utilitarian empiricism" (Lauer, cited in Bernal 1987, 277-78)—practical, not theoretical.

Example 13: Students reflect on Anderson's (1990) criticalmathematics curriculum ideas (summarized in Frankenstein & Powell, in press). Anderson (1990) theorizes that abstraction and compartmentalization are key factors in the alienation of capitalist society, "distanc[ing] people from their creative source and their creativity... allow[ing] capital to extract more surplus value from human labor and gain more control over our minds and socio-political activities of people." (p. 352) Instead, if we understand the creation and development of mathematics as inextricably linked to the material development of society, we undistort and uncover its hidden history.

So, in ancient agricultural societies, the needs for recording numerical information that demarcated the times to plant, gave rise to the development of calendars such as that found on the Ishango bone, dating between 9000 BC and 6500 BC, found at the fishing site of Lake Edwards in Zaire (Zaslavsky 1973). And, as African women, for the most part, were the first farmers, they were most probably the first people involved in the struggle to observe and understand nature, and therefore, to contribute to the development of mathematics (Anderson 1990). Then, as societies evolved, the more complex mathematical calculations that were needed to keep track of trade and commerce gave rise to the development of place-value notation by Babylonians (circa 2000 BC) (Joseph 1987). And this continues to the present day when, for example, military needs and funding drive the development of "artificial intelligence" (Weizenbaum 1985).

Criticalmathematics Literacy and "Multicultural" Education: Connections to Critical Structural Change in Society?

Samora Machel (1978) argues that one of the ways colonialism crushed African society "was the 'folklorising' of culture, its reduction to more or less picturesque habits and customs to impose in their place the values of colonialism" (p. 400). This analysis reminds us that "multicultural" education must avoid becoming trivialized by ignoring issues of power and by presenting the intellectual contribution of various cultures out of context, as some interesting "curiosities."

In this chapter, I have illustrated my attempts to incorporate meaningful "multicultural" education into my criticalmathematics

literacy curriculum. In general, this process involves the underlying philosophy and attitudes expressed in the definition of the "criticalmathematics educator." In my course, it involves including an analysis of institutional power in critically examining the effects of racism, sexism, monopoly capitalism and other alienating institutional structures in our society. It also involves empowering students to take control of their own learning through analysis of relevant mathematics education research. And it involves learning about mathematical ideas as they have been created from the material needs of particular societies, so that students recognize their own mathematical ideas and realize that mathematical ideas must be developed in every society. Finally, it involves studying the hidden history of the creation of mathematical knowledge, so that it becomes clear that all cultures have contributed to the development of this knowledge, and so that all students feel a sense of cultural affirmation and participation in what Anderson (1990) calls "Worldmath." However, Machel (1978) also argues that colonialism took over the institutions of African society in its exploitation of those countries. Can a meaningful "multicultural" education move beyond cultural affirmation to economic and political empowerment? My students' evaluations indicate that the course succeeds in convincing them of the importance of mathematics in analyzing issues, and, on occasion, even changes their minds about some of those issues. Following are several anonymous evaluations:

> The one big thing I learned: math is not relegated to the classroom but is truly connected with everyday life and the outside world. Learning math truly helps one deal with life better.

> I've learned to open my mind to new ideas; I've learned that there are several ways to the same end; I've learned to listen to "all" sides; I've learned to give it a try, even when I'm not sure; I've learned to look deeper at the numbers; I've learned to look "behind" those numbers. It made me become more critical and aware of what I read.

> I have learned to analyze certain situations and evaluate them with caution because not everything that we read is what it appears to be.

> I've learned to question [numbers'] significance as they apply to our society.... I've learned about discrimination, the hidden and misconceptions of learning math and its history.

My experience about our math class has me thinking more about how the "little people" are cheated....I have changed my way of thinking.

But these comments are still a long way from changing society. Realistically, as I have concluded in previous writings (Frankenstein 1987), probably the most that a criticalmathematics literacy can achieve is a subtle shift in ideological climate that will loosen up those forces blocking serious structural change for the real empowerment of all people. Fasheh (1982) is more optimistic:

...teaching math through cultural relevance and personal experiences helps the learners know more about reality, culture, society and themselves. That will, in turn, help them become more aware, more critical, more appreciative, and more self-confident. It will help them build new perspectives and syntheses, and seek new alternatives, and, hopefully will help them transform some existing structures and relations. (p. 8)

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Part III:
Multiculturalism and Assessment

10

The Teacher Shortage and Testing: Simple Ignorance or Racism?

G. Pritchy Smith

The number of teachers of color has been declining since the late 1970s. The decline is particularly evident among African American, Hispanic, and Native American teachers. Some studies have noted a slight increase in the numbers of Asian American teachers, a group that has been historically more underrepresented than most other groups. There are several reasons for the decline. Some authorities and researchers have argued that the shortage is merely a pipeline issue that if minority access to quality education from kindergarten through post-secondary education were effectively achieved, this teacher shortage would solve itself. There is an element of truth to this view; however, policies that require teacher admission and certification testing have had a much greater impact on creating a shortage of teachers of color than most authorities recognize. Research on passing rates and the numbers of teachers of color that have been excluded from the teaching profession clearly substantiate the contributing role of testing in creating the shortage.

Analyzing testing in the context of conflict and critical theory, the profession has good reason to question the motivation behind the teacher testing movement. The use of policy to legitimize practices which create and maintain inequities in the American educational system must be examined by the collective profession of teacher educators, teachers, and educational leaders. There is considerable evidence that teacher testing is but one of several historical trends and phenomena that resulted in limiting minority access to the profession of teaching. The profession must also examine the literature on validity of the currently used teacher tests. Thus, the profession is obliged to answer important questions about teacher testing. Can technically indefensible tests that do not themselves meet standards of quality be used to assure the quality of teachers? What is the real motivation behind the teacher testing movement? And, is teacher testing so

vigorously defended because the profession is uninformed; or is the testing movement driven by subtle, institutionalized racism?

The Shortage of Teachers of Color

The minority teaching force in America is rapidly dwindling. Most available evidence indicates that the minority teaching force will represent only about 5% of the national teaching force by the year 2000 as Smith (1984a,b; 1986; 1987a,b) and others (Goertz, Ekstrom, & Coley 1984) have reported. According to the American Association of Colleges for Teacher Education's 1987 member survey, college students in elementary and secondary teacher education programs are 90% White, about 4.4% Black, 2% Hispanic, 1.8% Asian, and less than 1% Native American (AACTE 1987). The meager numbers of candidates of color presently in the training pipeline in America's institutions of higher education will likely be cut in half by the candidates' subsequent failure to pass teacher competency tests required for licensure in most states.

America will need 1.5 million teachers between 1987 and 1992. If current enrollment trends in teacher education are not altered, universities and colleges will graduate only about 700,000 newly trained teachers (Darling-Hammond 1987). Supplying well-prepared, compassionate teachers in sufficient numbers for America's classrooms is problem enough; but the even more grave problem of providing sufficient numbers of certified teachers of color seems impossible. To achieve parity (defined as a national minority teaching force equal to the minority student representation in the K-12 public school population) would require the preparation and certification of 450,000 teachers of color among the 1.5 million teachers needed for our schools during the next five years. In truth, of the 700,000 new teachers who will actually be trained during this period, only about 35,000 will be people of color. It has now become commonly reported that U.S. institutions graduate only about 100,000 students of color each year and that only about 10,000 major in elementary and secondary education. Placing this data in the context of the preparation of teachers for the urban areas of the nation, Haberman (1987) corroborates the bleak view that parity between teachers and pupils of color is an unachievable short-term goal:

> By the year 2000, 50 percent of all urban school children will be from ethnic minority groups. Concurrently, only five percent of *all* college students will be from ethnic minorities. This small percentage is the pool preparing for *all* professions, not just for the teaching profession.... Indeed, if every minority group member in college became a teacher, minorities would still not be adequately represented. (p.3)

This unfortunate scenario has grave implications, not only for children and an already ailing American public education system, but also for the social, political, and economic development of our country. Therefore, an examination of the reasons for the minority teacher shortage should prove instructive for the profession's efforts to reverse the trend.

Reasons for This Teacher Shortage

As early as 1979, over a decade ago, dire predictions forecasting a shortage of teachers of color were made but largely dismissed by policy makers. Despite hundreds of articles in popular media and scholarly journals from 1979 to 1988, policy initiatives to respond to this significant issue have been few. An AACTE survey found that only fourteen states have initiatives to recruit minorities into teaching, and no federal programs focus on minorities in teaching (AACTE 1987). Of the fourteen state programs, most were rather weak efforts with questionable potential to exert any great impact on the total numbers of new minority teachers.

During the period following the 1987 AACTE survey up to 1991, the profession has witnessed the creation of an enormous number of minority recruiting initiatives implemented by individual school districts, colleges and departments of education, and occasionally, state departments of education. An impressive body of literature exists which describes many of these initiatives and recruiting programs (AACTE 1988; Alston 1988; Dupuis 1989; Education Commission of the States [ECS] 1990; Middleton & Mason 1988; Smith 1989; Tennesee Association of Colleges of Teacher Education [TACTE] 1988). A few colleges of education have redirected some of their regular state-allocated budgets to some of these recruiting programs; but most of the recruiting programs are supported by private funds

and, therefore, cannot really be called "state" initiatives. A few state departments of education and state legislatures have created minority teacher scholarships; but few state policy initiatives have courageously addressed such barriers as testing requirements in a manner that will actually increase the number of minorities in teaching. Most recruiting programs are too new to have empirical evidence to show any major increase in the number of certified teachers of color, and the evidence that does exist presents a discouraging picture of the potential of these programs to change minority representation at the national level (Dilworth 1990).

There has been wide speculation regarding the reasons for the shortage. One set of reasons centers upon the decline of new teachers of color entering the profession; a second set of reasons centers upon factors that help explain the loss of experienced teachers of color. With regard to the former, oft-given reasons for the shortage have been the declining representation of minorities among high school graduates, underpreparation of large numbers of students of color who previously were graduating from high school, the increased use of higher SAT/ACT scores and higher grade point average admission requirements by colleges and universities, the declining representation of most minority groups in higher education, the declining interest of students of color in teacher education as a college major, the lure of more lucrative and prestigious career fields that were previously closed to them, the reduction in financial aid during the 1980s, and the advent of admission and teacher certification testing in most states. Evidence supports all of these reasons for the declining numbers of entering teachers of color.

Reviews by Witty (1982), Witty and Jones (1982), Baratz (1986), Graham (1987), and Darling-Hammond, Pittman, and Ottinger (1987) provide authoritative consensus regarding the reasons for the shortage of entering teachers of color. One or more and sometimes all of these authorities provide empirical evidence to support all of the contributing factors to the shortage that are listed in the preceding paragraph. In addition, most of these scholars emphasize the interactive nature of the casual factors and differ mainly on points of emphasis and interpretation of the weighted importance of each separate reason.

Witty and Jones (1982), Baratz (1986), Graham (1987), and Darling-Hammond (1987) discuss all of the aforementioned factors,

but Graham (1987) asserts that the number of Blacks majoring in education has dropped at twice the rate of decline for Whites—not because of greater access to better paying, higher status professions —but because of reduced participation in higher education, poor educational background, and low performance on teacher tests. Darling-Hammond acknowledges the elimination effect of teacher education admission and licensure tests but de-emphasizes the impact of testing in comparison to the other factors.

It is unnecessary to repeat the numerical and statistical evidence that writers have provided to support trends in the declining representation of students of color among high school and college graduates, the underpreparation of graduates of color from high school, the impact of higher college and university admission standards, and the declining interest of students of color in the education major. Rather, the focus here will be directed toward a brief review of *Career Choices for Minorities: Who Will Teach?* (Darling-Hammond 1987) and a recent treatise on the minority teacher shortage by Barbara Hatton (1988). Together, these two analyses summarize most factors influencing the decline of teachers of color and together provide sufficient basis to direct attention to the often underplayed role of testing as a major reason for the minority teacher shortage.

Career Choices for Minorities: Who Will Teach? is one of the most comprehensive attempts to explain the minority teacher shortage by examining the education pipeline through which new teachers must pass. The following excerpts summarize several of the conclusions of this important report by Darling-Hammond and colleagues (1987):

> The decreased interest on the part of minority college students in entering education has been pronounced and unmistakable since the early 1970s. Data on college participation, intended fields of study, earned degrees, and entrance into teaching among those qualified to teach show that decreases in the prospective teaching pool are most notable for blacks, who have traditionally been most overrepresented among teachers; that Asians are the most seriously underrepresented among prospective teachers; and that growth in other, nontraditional fields of study has occurred for all minority groups, especially in the sciences and the professions. ...[S]everal concurrent trends... may be related to the dwindling supply of minority teachers. First, equalization of educational and job opportunities since the1960s spurred an exodus of minorities away from teaching and toward other better paying fields in the 1970s. Second, a surplus of teachers in the late 1970s, and declining teacher

salaries, pushed many who may have wanted to teach toward fields with better job prospects. Finally, undergraduate participation for Blacks, Hispanics, and Native Americans appears to have declined somewhat during the early 1980s. With less financial aid available, fewer low- to moderate-income students have been able to attend and complete college. Since teaching has tended to attract first-generation college attenders, for whom it represents upward career mobility, these trends have probably decreased the pool of prospective teachers as well. (p. 75)

Darling-Hammond also indicates in her report that admission and certification tests have contributed to the declining numbers of minorities entering teaching. Noting that much of the decline in minority entrance to teacher education programs was well established prior to the implementation of most state testing programs, she concludes that testing as a causal factor is too recent to explain fully the minority shortage.

Hatton (1988) discusses most of the already mentioned factors related to the decline in minority teachers but attributes much of the decline to educational reforms of the 1980s that have gone awry and to the effects of some of the reforms on historically Black institutions. Hatton offers this assessment of reasons for the minority teacher shortage:

During the early stage of the current reform movement, some educational leaders were able to use reform measures to promote organizational change, to set high expectations for all students, and to encourage the development of particularized strategies to meet special needs of students.

In many instances, however, the way the early reforms were carried out frustrated the long-standing goals of increasing the performance and raising the college enrollment rates of minority students. Consider the emphasis on raising admission standards and assessing student achievement. Some educators and educational institutions have taken these measures as an incentive to simply screen out those students who do not meet the new standards.

Within... [a] larger trend [of declining numbers and proportions of minority students in colleges and universities] is a sharp drop in the number of Black and other minority education graduates. This is clearly related to another basic reform strategy: the elevation of standards in teacher education programs in order to improve the quality of teachers. Efforts here have been devoted to using teacher certification tests to screen out so-called incompetents and using test results to evaluate teacher education programs for state accreditation purposes.

In the short term, these efforts have not resulted in the positive consequence of having more Black and other minority students meet higher standards. ...Minority teacher candidates have much lower passing rates on required certification tests than their White counterparts. Not incidentally, then, the percentage of minority teachers in the teaching force is declining—at a time when the percentage of minority pupils in the nation's schools is rising.

The historically Black institutions have been severely affected by the public identification of Blacks and other minorities as unlikely to pass required certification tests and secure professional placement. Alone with relatively low pay and poor working conditions in public schools, such identification may have served as a further deterrent to Black and minority students considering a teaching career, whether they are enrolled in historical Black or predominantly White institutions. Moreover, as historically Black institutions retrench, this continuing identification may inspire them to limit or close their teacher education programs. To the extent that this occurs, the potential for addressing the shortage of Black teachers is diminished. (pp. 66-67)

Exacerbating the shortage of new teachers of color are factors related to the attrition of *experienced minority teachers*, a phenomenon difficult to substantiate fully with empirical evidence. *The Metropolitan Life Survey of the American Teacher 1988* found that Black and Hispanic teachers say that they are more likely than nonminorities to leave the profession:

- Overall, 40% of the minority teachers say they are likely to leave teaching over the next five years compared to 25% of the non-minority teachers.

- Almost three out of four of the dissatisfied minority teachers say they are likely to leave, compared to about half of the dissatisfied non-minority teachers.

- Even among minorities who are very satisfied with their careers as teachers, more than one out of five say that they are likely to leave.

- Less experienced minority teachers are the most likely to say they will leave. Fully 55% of minority teachers with less than five years of teaching experience say they are likely to leave the profession. (Louis Harris & Associates 1988, p. 5)

Interacting with voluntary attrition caused by dissatisfaction with the profession is attrition through retirement. It is hypothesized that

between 25% and 30% of the currently employed minority teachers, particularly Black teachers in the seventeen southern and border states, are rapidly approaching retirement. Although comprehensive state-by-state data are not available to verify this trend, Kauchak (1984) found that 47% of the Louisiana teachers with 15 or more year's experience were Black, and Warner (1986) reported that in 1985 that 28% of the Black teachers and 27% of the Black principals in North Carolina had 25 or more years of experience and were eligible for retirement. This large number of teachers of color in the career pipeline who are approaching retirement, combined with reduced numbers of entering new teachers, forebodes an even greater reduction in the minority teacher representation than many authorities may have predicted.

Teacher Testing and Minority Teachers

The severe degree to which teacher testing is contributing to the shortage of minority teachers must be understood within the context of a description of the breadth of the teacher testing movement and the evidence regarding the disproportionately low test performance of minorities as reported by scholars and researchers from 1979 through 1991.

Description of the Teacher Testing Movement. Spreading rapidly from its origin in the southern states in the midseventies to all regions of the nation in little more than a decade, the teacher competency testing movement has evolved into a variety of testing programs that include admission and certification testing and, more recently, on-the-job assessment. Until 1987, Sandefur (1986b) provided annually the most comprehensive state-by-state profile of the movement. He reported that with 46 states having legislative or board of education mandates to test and three additional states planning testing programs, only Alaska remained with no plans to test the competency of prospective teachers. Results of the last survey (presented in Table 1 of the Appendix to this chapter) point to similarities and differences in the state-mandated testing programs:

State board of education mandates for testing outnumber legislative mandates 32 to 20. It should be noted that six states have both board of education

and legislative mandates. It is interesting to note that 10 of the mandates occurred between 1975 and 1979, 28 between 1980 and 1984, and eight in 1985 and 1986.

Twenty-five states require testing for admission to teacher education programs. The Pre-Professional Skills Test (PPST) and the California Achievement Test (CAT) are the most commonly used tests, although a few states have minimum required scores on the Scholastic Aptitude Test (SAT) and the American College Test (ACT). All of the admissions tests reflect the concern that applicants to teacher education programs be competent in the basic skills of communications and mathematics. In most states, students in teacher education also are required now to hold minimum grade point averages in excess of those required for retention in the situation. Typical GPA requirements range from 2.2 to 2.5 on a 4.0 scale.

Forty-one states require some form of testing prior to certification. In rank order, the concerns for certification are that the applicant be proficient in the basic skills (44), professional knowledge (32), subject content (31), and demonstration of competence on the job (14). Of the 46 states testing, 31 use a standardized test. The National Teachers Examination (NTE) and the PPST (26), produced by the Educational Testing Service, are by far the most common. Sixteen use customized tests usually developed within the state, although a few states reported contracts with National Evaluation Systems (NES) to develop state tests. Eight states use both a national standardized test and a customized test. Six states either did not report the tests used or have not yet selected them.

In states reporting cutoff scores on the ACT, the usual range was from 16 to 18. SAT cutoff scores ranged from 735 to 850. The NTE minimum passing scores range from 640 to 649 for general knowledge, and 630 to 648 for professional knowledge. (p. 12)

Several observations can be made about teacher testing as a movement. First, the initiative came from state legislatures and boards of education rather than from teachers or colleges of education. Second, states employ the same tests differently. An extreme example of this pattern can be illustrated by the use of the PPST, primarily a test that purports to measure basic skills, in Texas and Delaware. In Texas, the PPST is used as an admission test for entry into teacher education programs. In Delaware, however, the PPST is required for certification and, therefore, is used more like an exit test. Third, the level at which teacher candidates are required to be "competent" varies from state to state. For example, most candidates in California are admitted to teacher education programs upon completion of a bachelors degree

and are required to take the CBEST which is, for practical purposes, the same test as the PPST that was required, until recently, of undergraduates in Texas prior to entry to teacher education programs during the junior year. Fourth, a significant number of states that lead the teacher competency movement by early adoption of a testing program were also states that were under federal mandate for many years to desegregate their institutions of higher education. Fifth, the only three states to test practicing teachers—Arkansas, Texas, and Georgia—fall into this same category. Sixth, testing rigor (defined as the number of skill areas assessed) varies considerably from state to state, but is concentrated primarily in states (excepting South Dakota) that are among those often referred to in the literature as the seventeen southern and border states. For example, testing programs in Florida, Kentucky, Mississippi, North Carolina, South Carolina, and Texas assess every aspect that can be assessed. That is, these states require tests for both admission and certification; and they purport to assess competence in basic skills, professional knowledge, academic knowledge of the teaching field, and on-the-job performance. States which may not require admission tests but require tests in the maximum number of skill areas assessed in any state are Florida, Kentucky, Mississippi, North Carolina, Oklahoma, Pennsylvania, South Carolina, South Dakota, Texas, and Virginia.[1] Other states which would ordinarily be associated with the regional southern and border-state geographical descriptor such as Alabama, Louisiana, Georgia, Maryland, Tennessee, and West Virginia must be categorized, however, at the next lower level of testing rigor. These states are among those with formal assessment programs that attempt to measure only three of the four skill areas—basic, professional, academic, and on the job. When these criteria to define testing rigor are used as the basis for analysis, geographical or regional distinctions diminish almost entirely.

Performance on Teacher Competency Tests. As early as 1979, the disproportionate impact of competency testing on teachers of color was

1. Categorizing Florida as one of the states that assess all four skill areas is not a conclusion that can be drawn from Sandefur's table. Florida did not add tests in the academic subject fields with 1989-90 after Sandefur's 1986 survey. Testing programs have changed in a number of states since Sandefur's 1986 survey; therefore, excepting data on Florida, the observations noted about the teacher testing movement are based on the status of testing programs at the time of Sandefur's survey.

evident. Describing teaching as "the profession Blacks may lose," Trammer (1980, p. 69) and others (Mercer 1983; Mohr 1980; Scott 1979) noted the detrimental effects of competency testing on the professional pool of Black teachers. In a comprehensive analysis of historical and contemporary factors responsible for the diminishing number of Black teachers, Witty (1982) identified state-mandated competency testing as a threat to the very "survival of Black teacher in America" (p. 1). By 1984 sufficient statistical evidence from a few states began to emerge that suggested foreboding consequences for minority teachers. Reviewing the failure rates for Black students in Florida, Hoover (1984) alluded to teacher competency tests as "educational genocide for Blacks" (p. 70).

In an analysis of unresolved issues posed by the newly adopted Texas teacher assessment program, Vargas (1984) identified a similar threat to Hispanic teachers. Questioning blind acceptance of competency tests as the major instrument for improving public schools and teacher training programs, Gallegos (1984) echoed concern for Native American teachers, particularly those being displaced by Whites in Bureau of Indian Affairs schools in Arizona. Kauchak (1984) reported the alarming decline of Blacks entering the teaching force following the inception of competency testing in Louisiana. In a review of issues in teacher testing, Darling-Hammond and Wise (1984) concluded, "One important, direct effect of teacher competency testing is to decrease the supply of minority teaching candidates" (p. 16). Noting the severe rate at which minorities in ten states were being excluded by testing from teaching profession and the rapid rate at which states were mandating testing, Smith (1984a,b) projected that "minority representation in the national teaching force could be reduced to less than 5% by 1990" (p. 8). Observing that the nation "has never had an adequate supply of qualified Black, Hispanic, Asian, or Native American teachers," Dilworth (1984, p. 57) discussed state certification examinations as exacerbating an already existing crisis.

With more states adopting testing programs and more scholars addressing minority teacher issues between 1985 and 1987, the growing evidence continued to indicate that state-determined cutoff scores were consistently being set at levels high enough to eliminate disproportionate numbers of minority candidates. Using aggregated test scores from fifty states and the highest of three hypothetical

qualifying scores, Goertz and Pitcher (1985) predicted that "the teaching force would become 92% White and 5% Black by the year 2000" (p. 41). Garcia (1985) identified the admission and certification examinations used in most states, examined their validity, and noted the disturbing truth that examinations were having a devastating effect on minorities. George (1985) noted the serious impact of testing on historically Black institutions and on the numbers of role models of color in schools. Garibaldi (1986) noted the severe impact of the NTE on Black candidates in a comprehensive investigation of reasons for the decline of Black teachers in Louisiana. From teacher statistics in ten southern states from 1980-81 to 1983-84, Cooper and Williams (1986) attributed a 6.4% decline of minority teachers primarily to testing. Examining Black participation in education from the public school level through higher education, Baratz (1986) identified competency testing as a major factor among several responsible for declining numbers of Black teachers. Similarly, Anrig (1986) and Bracey (1986) acknowledged the detrimental effects of testing on minorities. Graham (1987) asserted that the number of Blacks majoring in education has dropped at twice the rate of decline for Whites, not because of greater access to better paying, higher status professions, but because of reduced participation in higher education, poor educational background, and low performance on teacher tests.

Despite numerous articles and reports that pointed to the effects of testing on the ethnic composition of the teaching force, comprehensive research to investigate the national ethnic impact of admission and certification testing through state-by-state analysis has been difficult to conduct and has been politically unpopular. In one of the earliest studies in 1984, test data could be collected and impact reported for only five states (Smith 1984a). In 1986, a second study collected test data and reported results for 10 states (Smith 1986; Smith 1987b). For the most part, during the 1980s financial support for assessing the ethnic impact of teacher testing was not readily available. State departments of educations were not given to funding research that was likely to reflect poorly on state policy, nor were federal agencies funding projects that were not consistent with the negative affirmative action agenda of the Reagan and Bush administrations. In 1987, the National Association of Education (NEA) and the Council of Chief State School Officers (CSSO) collaboratively

sponsored a research project to examine comprehensively the issues underlying the alarming decline in the number of minority teachers. A research team was assembled that consisted of Asa G. Hilliard from Georgia State University in Atlanta as director of the project and Linda Darling-Hammond from Rand Corporation, Walter Allen from The University of Michigan, Edward Haertel from Stanford University, and G. Pritchy Smith from the University of North Florida. The team was charged to investigate examination and career pipeline issues, policy effects and testing impact, and validity issues. By December, 1987, three of the four studies had been completed and revised into final drafts following the comments made by external reviewers. Although minor controversy engendered by one of the studies was reported (Fields 1988; Olson 1988), almost four years later in 1991 the NEA and the CCSSO have neither published nor widely distributed these studies, perhaps the most comprehensive, collective research effort that has been commissioned to investigate the factors responsible for the minority teacher shortage. Findings, however, from one of these studies on the impact of teacher testing in 19 states are reported in the following section.

Impact of Testing on Minority Teachers

The Effects of Competency Testing on the Supply of Minority Teachers (Smith 1987a) provides the most comprehensive, compelling evidence currently available to illustrate that testing has had a far more devastating effect on the supply of minority teachers than most authorities have admitted. This study examines the impact in nineteen states of state testing and other policies on minority participation in teaching. Typical first-time passing rates on admission and certification tests reported in the study range from 15% to 50% for Black candidates, 39% to 65% for Hispanic candidates, 37% to 77% for Asian American candidates, and 20% to 70% for Native American candidates, compared to 71% to 96% for White candidates (see Appendix Table 2).

Higher passing rates than the above typical passing rates, which appear in Appendix Table 2, are usually the result of either a very small ethnic group sample or a data collecting and reporting system that does not reflect true impact. For example, the high passing rates of

96% for White candidates and 94% for Black candidates in Tennessee is based on passing rates for institutions rather than ethnic groups and on self-reported scores. Most candidates who failed the NTE in Tennessee are not likely to have reported scores and, therefore, do not appear in a record of excluded applicants. *Apart from passing rates in Tennessee, New Jersey, and New Mexico where the available data do not permit an accurate assessment of impact, passing rates for Black candidates are below 50% in sixteen other states.* In four states—Virginia, New York, Alabama, and Oklahoma—passing rates for Black test-takers range from 41% to 47%. In nine states-Arizona, Arkansas, Connecticut, Florida, Georgia, North Carolina, Mississippi, Oregon, and Texas—passing rates for Black candidates or candidates from historically Black institutions range from 30% to 37%. In California the passing rate for Blacks is 26%. In Louisiana and South Carolina the passing rate for Blacks is below 20%.

The negative impact of competency tests on the racial composition of the national teaching force is probably greater than passing rates in Table 2 indicate. Where available, *the actual number of minority candidates passing tests and becoming certified indicates a crisis.* For example, since the inception of competency testing in Louisiana, state institutions have produced approximately 55 certified Black teachers per year. In 1981, Florida certified approximately 200 Black teachers out of an overall total of 5,500 certified teachers, a Black representation of 3.6%. The director of the Florida Office of Teacher Education has indicated that during five years of competency testing in Florida Blacks have represented 4.4% and Hispanics 2.8% of all the teachers certified (Rodman 1985). The most recent data indicate that during the six year period from 1981 to 1986 an average of only 178 Florida Black teachers a year have been certified. In Texas from May 1984 through June 1987 an average of only 252 prospective Black teachers per year out of an overall average of 12,145 prospective teachers passed the PPST and will take the certification examination when they complete teacher education programs. Passing rates on the certification examination from May 1986 through June/July 1987 indicate that the 252 Black candidates annually enrolled in teacher education programs could be reduced by as much as half by low scores on ExCET.

The situation does not differ significantly in most states where date are available. Estimated Black representation among teachers

being certified in Alabama is 5%; Arizona, 1.3%; Arkansas, 4.7%; California, 2.4%; Connecticut, 1.2%; Georgia, 10.4%; Louisiana, 4.3%; Mississippi, 7.0%; New York, 2.8%; North Carolina, 9.3%; Oklahoma, 1.7%; South Carolina, 3.0%; Texas, 2.1%; Virginia, 4.4%; and Washington, 0.7%. Estimated Hispanic representation among teachers being certified in Arizona is 4.7%; California, 3.9%; Connecticut, 0.9%; Florida, 2.6%; New York, 1.7%; Oklahoma, 0.06%; and Texas, 8.2%. Estimated Native American representation in Arizona is 2%; Oklahoma, 2.8%; California, 1%; and New York, 0.5%. Smith's study documents the elimination through admission and certification testing of an estimated 37,717 candidates and teachers of color, including 21,515 Blacks, 10,142 Hispanics, 1,626 Asians, 716 Native Americans, and 3,718 other minorities. Most of these teacher candidates have been eliminated within the past five years. The report also notes that if data were available for all test administrations in all states, the numbers eliminated would be much greater (Smith 1989a).

Other findings and conclusions are equally as disturbing and clearly indicate that policy initiatives from the recent reform movement have been partially responsible for the reduction in the minority teaching force. *First, the study found that regardless of the state and the type of competency test being used, disproportionate numbers of minority teachers are being screened from the teaching profession.* Differences in passing rates from state to state are due more to different examinations or different cut-off scores than to geographical or regional factors. Failure rates for people of color are high whether in California, Texas, New York, or Mississippi. *Second, the study targeted two state policy initiatives originating during the "excellence reform movement of the 1980s" that are clearly responsible for accelerating the decline of minority teachers. The requirement of minimum cut-off scores on undergraduate admission and certification tests and the requirement in some states that a specified percentage of an institution's graduates pass certification tests in order to retain state approval are two state policies that are reducing the numbers of minority teachers.* The testing requirements, including minimum SAT and ACT scores, for entry into teacher education so severely restrict the pool of candidates of color in most states that special recruiting programs and loan and scholarship incentives are rendered ineffective for increasing the number of minority teachers. For example, in Florida, with a minority public school enrollment of 32% and with a graduating high school class of

3,761 Black test-takers and 2,918 Hispanic test-takers, 82% of the Blacks and 63% of the Hispanics failed to post SAT scores high enough to be admitted to teacher education programs (Smith, Miller, & Joy 1988). The policy that ties teacher education program approval to student test scores discourages minority recruitment, utilization of exception policies for admission, and the development of alternative admission criteria (Smith 1987a).

Third, the study found that the impact of state-mandated testing on teacher education programs at historically Black institutions (HBIs) has been severe. This finding is particularly relevant to an analysis of factors contributing to the shortage of minority teachers since HBIs, institutions that have historically prepared the majority of currently employed teachers of color, are in danger of being rendered impotent to assist the nation in reversing the decline of minority teachers. Other findings related to HBIs are listed below:

- The most severely affected HBIs have been the private liberal arts institutions that had small programs prior to state-mandated testing. The impact on public HBIs is severe although somewhat less severe than on private HBIs. Evidence indicates that less than a dozen students annually are passing admission and certification tests at the smaller private liberal arts institutions. Similarly, evidence indicates that 50 or fewer students are annually passing tests to qualify for certification at most of the larger public HBIs.

- The general trends at HBIs are declining enrollments in teacher education programs and fewer graduates taking and passing certification tests, despite evidence that several institutions increased their overall passing rates.

- The requirement of minimum cutoff scores on undergraduate admission and certification tests and the requirement in some states that a specified percentage of an institution's graduates pass certification tests to maintain state approval are two state policies exerting a very negative impact on HBIs.

- No real evidence indicates that reduced enrollment in teacher education programs at HBIs is paralleled by increasing minority

enrollment at predominantly White institutions. For the most part, minority enrollment in teacher education programs has declined in all institutions.

- Little evidence indicates that predominantly White institutions prepare minority students to pass admission and certification examinations any better than do HBIs (Smith 1987a).

More recent unpublished research findings from a study sponsored by the Ford Foundation and targeted for completion in 1991 are predicted to indicate that close to 100,000 teachers of color will have been prevented by testing programs from entering the teaching profession. Such findings from the previous and the forthcoming study will make it difficult for members of the profession or state policy makers to avoid considering the motivation behind testing as something more political and social than mere "accountability." In fact, several scholars who have a historical view of previous assaults on the minority teaching force have already suggested that the teacher testing movement has its origin in racist policy reflective of the broader institutionalized racism of the society (Hoover 1984; Mercer 1983; & Sizemore 1986).

Historical Trends and Minority Teachers

It is beyond the scope of this chapter to provide a comprehensive history of teachers of color in America; but a few strands of history give perspective to the plight of the contemporary teacher of color, especially with regard to testing and, to some degree, in equitable funding patterns for quality education. There has been a tendency for scholars in professional education to perceive factors contributing to the minority teacher shortage as relatively new phenomena when, in fact, one could argue from historical data that those casual factors associated with testing and screening are merely modern manifestations of old ways to perpetuate inequity. The history of Western culture is replete with examples of the use of "scientific evidence" and screening devices, always in the name of "excellence and standards," to substantiate that those who already possess political and economic power are

superior to fill the professional roles of philosopher, military officer, scientist, physician, lawyer, and teacher. Professional educators need only to read Stephen Jay Gould's *The Mismeasure of Man* (1981) to sense the depth of the tragedy resulting from the use of false sciences, not only to measure humankind's talents and abilities but also to use modes of measurement to deny access. Over the course of history, particularly in America and Europe from the 1700s to the present, Gould notes that the instruments of craniometry, phylogeny, and modern IQ testing have been used to justify the exclusion of this or that group—sometimes women and always Africans, Native Americans, and other non-Whites. Having a short sense of history, most contemporary scholars writing about entrance and licensure examinations have been unable to interpret the current competency testing trend as an extension of the same biological determinism that charted a rather shameful but well established history of denial and exclusion.

Strands of modern history concerning teachers and students of color since Reconstruction, however, are most relevant to understanding some of the causal factors of the present decline in the number of teachers of color. One clear pattern that emerges in the history of education, particularly teacher education, is the cyclical concern for "quality and standards" and the accompanying de-emphasis upon "equity" that seems to parallel such concern. This concern has been expressed repeatedly in our history with regard to the quality of the preparation and licensure of teachers and the quality of the institutions that have prepared teachers.

Threaded throughout this historical concern for quality has been the changing stature of licensing examinations, which have been in and out of favor with professional educators during various periods of history in teacher preparation. This pattern can be seen in the brief history of teacher certification and Black teachers involvement in education provided by Dilworth (1984):

> It was not until the 1920s that teachers were required to go to school. Those aspiring to be educators had little incentive to attend normal school or college, especially if they were equipped to pass a licensing examination. There are data to suggest that in some situations school attendance could be substituted for teacher certification and that at times one could secure a slightly better and higher paying job (Tyack 1967).
>
> No state in 1898 required high school or professional training for the lower grade (local) teaching certification. By 1919, eleven states did. By mid-

century, six states still issued some form of teaching certificate on the basis of examination, while ten states had a minimum schooling requirement of 24-32 semester hours of study for elementary teaching certificates (Pangburn 1932).

For the first decade of this century, the majority of classroom teachers had eight or less years of education, while Black teachers had only six (Jones 1916). It would seem that a two year difference in level of schooling would be less than significant. However, the type (i.e. curriculum, facilities, faculty) of training provided Blacks was woefully insufficient.

The educational requirements for teachers became more exact as the profession expanded. Still, only 10 percent of classroom teachers in 1931 had bachelor degrees. By 1952 that figure was less than 50 percent. By 1961, only 14.6 percent of public school teachers had less than a B.A. degree. In 1976, that group comprised less than one percent of the teaching population (*Condition of Education* 1979).

An increase in certification solely on the basis of college credentials and a decrease in certification via examination characterized this early period. Fortunately, the emphasis on academic preparation, as opposed to testing, was advantageous to Black teachers. Historically, Black teachers have been unable to achieve consistently the required results when quantitative test measures have been utilized. In fact, this very criterion may have deterred substantial decreases of Black teachers in the South during the integration years when more teachers in Black than White schools were fully certified (Coleman 1966).

It also is apparent that teachers as well as administrators saw the deficiencies in certification by examination. One author in 1932 stated: "[The public] no longer is willing to grant a license to teach to any person who is able by means of some sort of examination to exhibit a modicum of knowledge in addition to demonstrating to the reasonable satisfaction of the certifying authority that he is a person of good moral character" (Pangburn 1932, p.4).

Early teaching examinations were quite basic and were designed to cover the rudiments taught in the common schools. Subjects normally tested were orthography, reading, writing, arithmetic, grammar, geography, physiology, hygiene, and for a first or second grade certificate, some theory and practice of teaching. With the increasing emphasis on teaching methods and knowledge, the inadequacies of examination became more clear. Consequently, competency evaluation through observation, e.g., classroom performance and student teaching, dominated the new era. (pp. 5-6)

During the first 20 years of this century, passing an examination was considered more important than the level of education for qualifying teachers. Licensure examinations began to fall out of favor in

preference for secondary education, normal school preparatory and college degrees during the 1930s and 1940s. What is worthy of note here is that regardless of whether an examination or a higher level of education such as a college degree became the new determinant for teacher certification, these historical junctures of "new standards" became barriers to Black teachers and gave rise to interpretations of "the problem" in terms of "blaming the victim" or "blaming the educational institution" for the perceived deficiency, a pattern that unfortunately remains dominant in today's thinking. Citing a statement regarding licensure of Black teachers issued in 1917 by Arthur D. White, school inspector of the state of Virginia, Jones (cited in Dilworth 1984) provides supporting evidence of this pattern:

> Of the 854 teachers licensed, 377 were admitted on diplomas from recognized institutions and 477 passed examinations given by the State. The 477 who passed constituted only 36 percent of the total who took the examination. Only 28 received first grade certificates, 169 were second grade, and 280 were third grade. The appalling number of failures and the low grade of the majority of the certificates can mean but one thing—the inadequacy of the preparation of the applicants. This inadequacy of preparation is fundamental, reaching down into the elementary schools. How, then with inadequate elementary schools, or at least schools taught by inadequately prepared teachers, can we hope to improve our class of teachers? A careful survey of the situation points to but two sources from which relief may be expected—a greater number of publicly supported agencies for teacher training and a closer cooperation between the public school authorities and the existing private secondary schools for Negroes. (p. 16)

The competence of Black teachers came under scrutiny again with the onset of school integration following the 1954 *Brown v. Board of Education* decision of the U.S. Supreme Court. New attempts, particularly throughout the southern states, at resurrecting licensing tests, often the National Teacher Examinations, were made during the period following the *Brown* decision. However, until the mid-1970s courts seldom looked beyond discriminatory impact to rule tests and other selection procedures unconstitutional. A series of court cases involving employment and certification examinations began to establish that plaintiffs had to prove "discriminatory intent" rather than "discriminatory impact;" and, finally, with the 1978 U.S. Supreme court affirmation of a district court decision in *U.S. v. South Carolina*

(1977), the use of the NTE for teacher certification was upheld (Smith 1987b). The legal precedent established in this Supreme Court decision gave impetus to the rapid spread of the competency testing movement, first across the southern and border states, next in southwestern and western states, and finally throughout the northeastern and mid-western states until 1988 when all but one state, Alaska, had plans to implement some type of state-mandated test or tests for teacher candidates (Sandefur 1986a,b).

It is significant to note, however, that during the period from 1954 to the 1970s, when Black teachers were most under the protection of courts from screening devices, massive displacement of Black educators occurred throughout most of the same southern and border states that rapidly resurrected testing within a five year period following the 1978 court decision. Using data gathered by a National Education Association task force and the Southern Education Reporting Services, Ethridge (1979) reported that between 1954 and 1970, 31,584 Black educators lost their positions in the seventeen southern and border states.

Historically, scrutiny of Black teachers' competence has also taken the form of examining the "quality" of the HBIs where the largest percentage of Black teachers has been educated. Related to this issue are two evolutionary trends—the emergence of the concept of state certification for teachers and the development of regional accrediting associations. According to Dilworth's treatment of the impact of these two historical developments on Black teachers, the concept of state certification evolved from a point in 1898 when only three states issued teaching certificates to the present commonly known "approved program" approach. The approved program approach is a certification system whereby a state department of education reviews and approves an institution's teacher education programs and then grants certificates to those graduates who complete the program and who are recommended for certification by that institution's certification officer.

While the notion of state certification was taking root in American education, the rise of regional accrediting associations was also taking place. Because most HBIs were located in southern states, a discussion of the accrediting practices of the Southern Association of College and Secondary Schools (SACS) is most relevant here. The struggle to

attain full accreditation for HBIs was difficult and, no doubt, influenced by the racial attitudes of the day. Originally, SACS extended full membership to White institutions but extended only "approved list" status to HBIs. By 1930, seven HBIs were on the approved list roster; by 1948, 68 HBIs were placed on the approved list. It was not until 1961 that SACS extended full membership rights as "accredited" to HBIs (Dilworth 1984). Thus, during the twentieth century, many Black teachers have labored during various periods of time under the shadow of the larger society's perception that many graduated from "unaccredited" institutions.

This stigma has taken its toll and continues to cast a similar shadow over present efforts to address the minority teacher shortage. For example, as was noted earlier in the case of the competency testing movement, scrutiny of the quality of HBIs seems to have intensified with the onset of school integration and has culminated at present in policies that invoke the use of test scores to determine not regional accreditation, but the state accreditation status of "approved" teacher education programs in several southern states. This renewed threat of losing accreditation is disproportionately affecting HBIs and is reminiscent of earlier historical practices.

A review of the history of teacher certification and teachers of color is useful in making recommendations for reversing the shortage of minority teachers, particularly with regard to the notion that solving the minority teacher shortage will require us to rethink traditional approaches and avoid making past mistakes. For example, one pattern that clearly emerges from an analysis of historical trends is that reforms that represent an elevation of standards, whether in the form of tests or in the form of new accreditation standards, eventually take on the role of screening devices rather than the role of enhancing the development of students to meet those new standards. Further, such reforms have historically and continue to take on a punitive role against HBIs rather than a positive role in favor of developing the capacity of these institutions to achieve the new standards. The approach of installing new and elevated standards that convert shortly thereafter to barriers for minorities will not be a useful tactic to employ in solving the minority teacher shortage. The historical vignettes presented in this section of the paper speak clearly to this counterproductive approach in the past. There is no reason to assume different outcomes this time around.

The recurring historical pattern has been that new standards which often constituted barriers for minorities were interpreted by most conventional scholars and social commentators of the time as justifiable in the interest of "quality." On the other hand, as time passed and the detrimental racial impact of the new standards became clearer, scholars tended to reinterpret practices surrounding these new standards as having racist overtones. Despite general consensus that past practices were a part of historical racism in America, each new group of conventional scholars has insisted "it is different this time."

Most scholars have interpreted newly invoked standards in the context of "quality and excellence," rather than in the context of conspiracy theory. Indeed, this pattern appears to characterize the current excellence-versus-equity debate. Considering the past, policy makers would do well to include into the fold of advisors those scholars who have suggested that current reform practices have racist overtones. To do so will require a bold posture; for it is unfashionable presently, and has been during most historical periods, to discuss policy in terms of racism. This position was expressed by Carol Hobson Smith, National Alliance of Black School Administrators (NABSE) at AACTE's Wingspread Conference on recruiting minority teachers: "The position of minorities has not changed very much and will not change very much if we don't focus on racism" (AACTE 1988, p. 10). Restructuring our thinking to solve the minority teacher shortage may require placing racism on the agenda.

Recommendations on Admission and Certification Testing: A Question of Validity

Various recommendations have been made regarding admission and licensure testing. Several testing authorities (Haertel 1987; Haney, Madaus, & Krietzer 1987; Mitchel 1989; Smith 1988; Garcia 1989) and the Northeast Region Holmes Group (1988) have recommended discontinuance of teacher admission and licensure tests. After conducting perhaps the most comprehensive review of validation evidence to date on most admission and licensure examinations used in most states, Haertel concluded, "The use of these tests without stronger evidence of validity is bad psychometric practice" (p. 61). Haertel's investigation found currently used teacher examinations to have ques-

tionable content validity, highly questionable concurrent and construct validity, no evidence of criterion related and predictive validity, indefensible methods for establishing cut-off scores, no established body of research to show validity with regard to absence of test bias (across gender and cultural groups), and no established body of research to show they provide better evidence of teacher competency than do alternative assessment methods (Haertel 1987). In light of the above, Haertel made this final recommendation: "The adverse impact of these examinations on minority representation is amply documented....There is nothing to add, save to underscore the urgency of reconsidering testing requirements that are technically indefensible" (p. 52).

A second comprehensive review of validity issues that supports Haertel's findings and conclusions was conducted by Haney, Madaus, and Krietzer (1987). Contending that "test validation is an overall process involving content, criterion, and construct considerations" (p. 100), Haney, Madaus, and Kreitzer conducted a comprehensive review of test validation literature on the NTE and other teacher tests. Noting that "there is an abysmal lack of evidence available concerning the technical quality of teacher tests" (p. 198), they made the following four assertions:

1. Current standards of content validation of teacher tests by test developers and sponsors are inadequate.
2. Beyond content validation, predictive and concurrent validity studies are needed.
3. Beyond content and predictive validation studies, more inquiry into the construct validity of teacher tests is needed.
4. The manner in which tests are used, with specific cutoff scores, demand validity studies not only of the tests, but of specific cut-scores. (p. 197)

Research reported by Haney *et al.* based upon their own simulation analyses and data from Goertz and Pitcher (1985), also provides empirical evidence "that *current teacher tests, and the manner in which cut-scores are being set on them, are differentiating among candidates far more strongly on the basis of race than they are on the basis of teacher quality*" (p. 227). On the weight of this evidence, these writers make "a modest proposal: *do not use such tests and cut-scores until it is clearly proven that these tests select among teacher candidates more on the basis of some independent measure of teacher quality than on the basis of race*" (p. 227).

James W. Mitchell, Jr., director of the Buros Institutes for Mental Measurements and editor of the *Mental Measurement Yearbook* echoes validity issues similar to those addressed by Haertel and Haney *et al.* Mitchell (1989) emphasizes that the cumulative evidence from research indicates tests cannot predict who will be the most effective teachers, and this fact charges teacher educators with a clear cut responsibility:

> If the net outcome of the answer to the question, "Can tests predict who will be the most effective teachers?" is an emphatic "No," we must assess what this means in terms of communication with the general public. The general public seems to think, or acts as if it thinks, that all one has to do to insure effective teaching is to test prospective teachers to determine if they are well educated and know their subject-matter. They must be disabused of this notion and disabused in such a way that they don't jump to the conclusion that the teacher educator is only being defensive by declaring so. If this point is not made clear there will continue to be, as there has been in the past, the kind of futile acts of miscommunication that breed misguided proposals and legislation whose intents can never be realized. Democracy requires an educated citizenry and the ability to communicate from an informed knowledge base, and those of our citizens who think that the royal road to more effective teaching in our public schools is the establishment of a testing requirement are deluding themselves. (p. 6)

The Steering Committee of the Northeast Region Homes Group (Holmes Group 1988) has passed the following resolution:

> Be it resolved that the Steering Committee of the Northeast Homes Group recommend against the use of such cut-scores on teacher tests until such time as evidence is available to show that use of such cut-score differentiates among teacher candidates more on the basis of some independently measured indicators of teacher quality than on the basis of race. (p. 9)

Garcia (1989) and Smith (1988) recommend a moratorium on standardized tests for teacher selection and certification but further recommend the substitution of more flexible criteria. Garcia states:

> It is obvious that the best applicants are not being selected through the use of standardized tests. A moratorium on the use of standardized tests for admission to professional education programs, student teaching, graduation or certification is essential. A return to the use of multiple criteria including observed practice of teaching performance are better indicators of teaching competence. (pp. 39-40)

Similarly, Smith (1988) writes:

The practice of determining admission to teacher education programs and teacher certification on the basis of a single criterion such as a score on a pencil-paper standardized examination should be discontinued. Such examinations are narrow in scope and fail to assess the vast number of skills and effective teaching behaviors associated with high level performance in the classroom. Assessment for licensure should be a developmental, holistic process that involves the thoughtful judgments of professional educators. A wide range of talents, skills, and abilities should be assessed in relationship to each other and in the context of live interaction with students in the classroom. Standardized examinations cannot do these things. Assessment for licensure should focus first on portfolio development that documents a candidate's *diagnostic* test scores and the evidence of remediation of basic skill weaknesses, as well as evidence of higher level competency acquisition as obtained throughout the teacher education and content courses in a college or university's approved teacher education program. Second, assessment of the application of research-based knowledge and skills in a clinical internship setting should constitute the final determination of a candidates's readiness for licensure. A trained, certified team of observers consisting of professional educators (professors of education, content specialists, professional teachers) should assess a candidate's acquisition of teaching knowledge and skills. (pp. 10-11)

Somewhere between the recommendation to abolish admission and certification tests and the recommendation that rigorous testing is necessary lies the position reflected in recommendations by Hatton (1988):

Previous efforts to improve entry screening through assessment procedures have not been able to overcome the bias inherent in current testing procedures. The developers of the new certification process should be held accountable for developing a process that does not discriminate against minorities.

Tests and assessment procedures should not be eliminated. They should be improved and used to help students monitor their performance and challenge their achievement. Particular populations may require diverse approaches, but neither educators nor society should lower the expectation that teacher candidates who have completed degree programs can ultimately teach well. The minimum competency tests should never become the goal for any teacher preparation program.

Neither should these tests be allowed to become barriers.... We need to employ early identification and support strategies in order to help potential minority teachers overcome these barriers. (p. 68)

Gifford (1986) strongly recommends testing, but like Hatton, recommends sufficient support to assure the elimination of their disparate impact on minorities:

> I believe if properly used, well-constructed correctly standardized measures for prospective teachers are necessary for the development of the teaching profession and beneficial to the education of our young. If there is indeed a national commitment to quality education for all, as part of our dedication to the principles of equality, then suggestions to change the requirement to fit the present median performance of minorities will be ignored. Rather, the desired performance level will be retained, valid and unbiased tests will be developed, and minority students will be provided the kinds of support and training that will make it possible for them to garner the learning and experience needed to pass the examinations for entry into and exit from teaching credential programs. (p. 270)

Some states have made recommendations and in some cases implemented recommendations to ameliorate the effects of testing on efforts to increase the number of minority teachers. Although no state has voluntarily rescinded a legislative mandate for testing teachers, the Superintendent of Schools and the Alabama Board of Education have agreed to terms of an out-of-court settlement that require discontinuance of the Basic Professional Studies examination, payment of damages, and the award of certificates to selected Black educators who were eliminated by a testing program (Consent decree 1985). Florida has the 10% exception policy that permits a college of education to admit 10% of its candidates with ACT and SAT scores below the minimum required score. The Florida Education Standards Commission (1987) has recommended to the State Board of Education (1) that teacher education programs must provide evidence of implementing a procedure for recruitment of minorities as a standard for program approval and (2) that special pilot programs to recruit minority students into teacher education should be exempt from the state-mandated SAT/ACT admission requirements and the requirement that 80% of the graduates must pass the FTCE in order for colleges of education to maintain program approval. In New Mexico, a provision to provide a non-timed alternative route to the PPST for students for whom English is a second language has been recommended and implemented. The Missouri State Board of Education has recommended and permits students who do not meet the minimum entry level score

of 18 on the ACT or 800 on the SAT to demonstrate entry-level competency in appropriate college courses and on alternative tests administered by the institutions. The Ohio Board of Education's certification standards include provisions that require colleges and universities to prepare a formal plan for assessment that is free of cultural bias and that will diagnose student strengths and needs which must be addressed throughout the teacher education program (Sandefur 1986a).

In summary, diverse recommendations regarding entry and exit teacher testing reflect a divided profession. Some authorities find it untenable to support psychometrically invalid instruments. Others believe testing should continue despite the fact that current invalid tests are disproportionately eliminating minorities. The latter seem to have faith that teaching competence can be measured, that valid instruments will be developed, and that the necessary support will be forthcoming to improve minority performance on the tests.

Assessment of Recommendations

The recommendations regarding tests that are disproportionately eliminating minority candidates reflect wide-ranging opinion among authorities. Most educators and many authorities seem disinclined to object to eliminating tests, despite the fact that there is far more empirical evidence to support their elimination than there is to support their use. The testing issue needs continuing airing. The range of emotions elicited by any suggestion that the tests are psychometrically indefensible and should be eliminated is reflected in the statements made by newspaper columnists and respected scholars. William Raspberry, for example, (1983) has written:

> There's a lot we don't know about educating our children, particularly disadvantaged children. That's a failure of information, which is bad enough.
>
> But we know a lot more than we are willing to act on....We know that a lot of our teachers aren't as good as they ought to be. But we—and here I mean specifically the civil rights leadership—balk at insisting that incompetent teachers be weeded out, particularly if they are minorities. We'd rather feel sorry for them, as victims of society, than hold them to standards that improve the quality of the schools for our children...
>
> We can have well-educated children or ignorant teachers. We cannot have both.

Similarly, Galambos (1984) presented a dilemma posed by testing for quality and the need for minority teachers as role models:

> The bottom line of the problem centers on what will have the greater impact on children in the schools: the lack of role models on minority children if Black representation among teachers declines, or the possibility that teachers with less than minimum qualifications will teach in the nation's schools. (p. 9)

Gifford (1985) also presented a germane point of view regarding testing:

> We must always be mindful that the effectiveness of our school systems will not be found in the statistics on the racial composition of our teaching staffs but rather in the statistics reflecting mastery of basic skills in reading, writing, and arithmetic by all our students.... There is no equity in absence of excellence. If we are to meet our moral and legal responsibilities to both the potential teachers in our population and to their future students, we must continue to employ valid, job related written examinations of potential teachers' basic skills. (p. 62)

Mary Futrell, president of the National Education Association, stated:

> I've heard some say that pre-service testing may hurt women and minorities.... As a Black woman, I don't buy that. As a matter of fact, I resent it. If we set clear and demanding expectations and then help all potential teachers reach those expectations, we can have both quality and equality. (Rebell 1986, p. 398)

Another point of view relevant to this discussion is that of Mehrens (1987):

> The solution to the problem of incompetent teachers be they Black or White is to work at increasing their competence, not allowing them to teach in spite of their incompetence due to sympathy, guilt, or some perversion of the notion of justice. (p. 83)

Opinions as expressed above can be appreciated, but they are an insufficient basis upon which to make informed decisions regarding entry into the profession of teaching. The bottom line on current admission and licensure examinations is that they do not have sufficient technical quality to meet the 1985 *Standards for Educational and Psycho-*

logical Testing. As the validity literature indicates, the currently used examinations have questionable content validity, highly questionable concurrent and construct validity, no evidence of criterion-related and predictive validity, indefensible methods for establishing cut-off scores, no established body of research to show validity with regard to absence of test bias (across gender and cultural groups), and no established body of research to show that they provide better evidence of teacher competency than do alternative assessment methods. It can be said that these examinations do have high reliability coefficients and that they meet the legally permissible standards of validity set forth in *United States v. South Carolina* (1977). Given that high reliability coefficients have little meaning in the context of inadequate decision rules for establishing cut-off scores and that legally permissible court standards for validation by expert opinion fall ridiculously short of the professionally established 1985 *Standards*, the only position that a scientifically-minded profession can take is to call for the discontinuation of all current invalid tests. Even if admission and certification tests were not having a disparate impact on most minority groups, they should be discontinued for their lack of technical quality. That they are being used as a tool for social control to screen out rather than diagnose weaknesses of teacher candidates who need remediation is a secondary, but significant, reason to recommend their abolishment.

Some authorities recommend that, in order to expand the pool, less able students of color should be recruited into teacher education programs and that developmental programs can be designed to raise the admission or certification test scores of these students. These recommendations are often advanced by authorities who believe that we can have both testing and equity and that we can have testing and still greatly increase the numbers of teachers of color. This tack reflects deep, fundamental American beliefs about what education can accomplish. A word of caution is due here, however. Theoretically, this approach is possible; however, there is scant empirical evidence that it has actually been done very well or even to any great extent. The degree to which test scores can actually be raised is one of the loaded emotional issues that most authorities skirt. It is an issue that must be aired, however, if serious progress is to be made in reversing the trend of declining numbers of minority teachers.

Success stories exist about institutions that have worked cooperatively with testing companies, revised curricula, and provided pro-

grams to increase academic skills and test-taking seminars to raise the passing rates of students on certification examinations. Some of these institutions have raised initial passing rates of 15% to 30% to above 90%. It does not appear true, however, that these programs have greatly *increased the number* of minority graduates passing tests and earning certificates. It also appears that most of the increase *in passing rates* at these institutions may be due more to rigorous prescreening of candidates than to curriculum revisions, developmental-skills programs, and test-taking seminars. There appears to be no empirical evidence yet to show what single factor or combination of factors account for passing rate increases. For the most part, the number of certified teacher education graduates from these institutions has plummeted to a fraction of what the number was prior to the advent of testing.

Presently there appears to be little empirical evidence that programs have been designed that have raised or can raise test scores of the large number of students who would have been in teacher education programs had prescreening not occurred or who would have been in teacher education had there been no testing at all. Evidence indicates that institutional passing rates can be raised significantly, but only at the expense of reducing the numbers and, therefore admitting only the proven elite test-takers. Evidence shows that college developmental-skills programs and test-taking seminars may raise scores of individual students but are seldom able to raise group mean scores more than the margin of error on a well-developed standardized test.

There are psychometric reasons for most teacher education programs being unable to raise certification test scores dramatically. First, if a nonreferenced examination has been well-designed, it should be resistant to coaching. Secondly, programs can be designed to raise test scores only if the test is truly criterion referenced. Even though some teacher tests are titled "criterion-referenced," they are indeed not. If the criteria were clearly specified in terms of the exact pieces of knowledge students must learn, programs could be developed that would raise students' scores. Unfortunately, program designers and students alike must try to outguess which few pieces of information from the vast universe of knowledge will be tested. Consequently, only those students who have acquired test-taking skills and cumulative knowledge over several years duration are likely to perform consistently well on standardized tests. It is questionable whether or not many students who have been outside of the educational mainstream

during most of their school years can show dramatic score improvement as a result of seminars or, in cases of extreme basic skills deficiencies, even two- or three- year compensatory programs.

An even greater problem regarding developmental-skills programs and testing surfaces in view of the fact that little research has been conducted to determine whether or not students who fail existing admission and certification tests *actually are* academically deficient. Other measures of competence suggest that many are not. For example, 21% of the college students and 18% of the college graduates with self-reported GPAs of 3.5 to 4.0 and 39% of the college students and 28% of the college graduates with self-reported GPAs of 3.0 to 3.49 failed the California Basic Educational Skills Test (CBEST), the examination used to determine admission into teacher education programs (California Commission on Teacher Credentialing 1984). It is difficult to accept that some students who would be declared by one measure as honor students actually are "academically marginal" because a test score says so. Thus, program designers who believe standardized test scores represent "standards of quality" may find themselves caught in a loser's trap trying to win a game that empirical evidence suggests may not be winnable. Indeed, dollars may be spent, enormous amounts of energy may be expended, students may be recruited, some students may, in fact, be prepared to pass competency tests, but the vast undersupply of teachers may not in the end be offset. Moreover, when all is said and done, many of the candidates who were eliminated may not have been, in reality, incompetent.

The bottom line on university programs designed to raise test scores is that institutions must continue to operate them, that states with testing mandates are obligated to fund them, and that the profession needs hard evidence to show how these programs actually raise the test scores of so-called academically marginal students.

Conclusion

Admission testing for teacher education and certification testing with pencil-paper tests are factors, among several others, contributing to the minority teacher shortage. As one of the nation's most critical educational problems, the minority teacher shortage forces professional educators to ask why the shortage exists. The complex tangle of interacting causal factors is all too familiar—the declining representa-

tion of students of color among high school graduates, the underpreparation of large numbers of students of color who are graduating from high school, the increased use of higher ACT/SAT scores and higher grade point average admission requirements by colleges and universities, the declining representation of most minority groups in higher education, the declining interest of students of color in teacher education as a major, the lure of more prestigious career fields that were previously closed to people of color, the reduction of financial aid during the 1980s, and the advent of admission and teacher certification testing in most states. Despite the evidence to support all these reasons for the minority teacher shortage, they appear to be reasons that lie on the surface. They, in fact, appear to be more akin to effects than causes and beg the profession to plumb beneath them to discover deeper reasons. Indeed, the common thread that binds together these commonly presented reasons is that most of them are rooted in policy, rule making that governs the educational system from kindergarten through higher education. Policy, of course, can be changed. In the final analysis, policies are the creations of people and as such are reflections of their belief systems.

Why then, after over a decade of policies that guarantee a shortage of minority teachers, do these policies persist? The answer to this question is not an easy one, nor one that is flattering to a democratic nation—nor is it one that the profession wants to hear. One might just as well ask why the nation has historically fallen short of addressing satisfactorily its responsibility to educate minorities or the children of the poor. To imply that policies are part of the problem suggests that those who have the power of policy making have not just "fallen short," but have "planned to fall short." This line of reasoning requires us to think about the minority teacher shortage as the result of *deliberate action* rather than as some unfortunate, incidental consequence or by-product of a movement toward accountability.

Viewed from the broader views of conflict theory (Bowles 1977; Beck & Colclough 1987) or critical theory (Giroux & McLauren 1987; Giroux 1991), teacher testing takes its place among many other practices rooted in policies that serve as tools of social control to assure that those who have privilege will continue to do so and those who are locked out will remain excluded. The most common of these practices that reflect the American preference for meritocracy to favor the mainstream culture—rather than a practiced democracy for all—

are well known—standardized testing, ability grouping, racially segregated schools and classes, inequitable funding patterns for schools, racially disproportionate expulsion and suspension, and discriminatory patterns of teacher interaction and lower expectations for culturally different students. Another way to describe these practices that guarantee inequity is to call them manifestations of racism, a racism that is so deeply imbedded in America's history and so deeply repressed in America's collective psyche that even the most educated of American citizens are enabled to deny what they really are.

Since accusations of racism are serious business and not appreciated in societies that profess democracy, perhaps it would be more productive to suggest that the inequitable effects of policies are the result of simple ignorance. That is, perhaps policy makers and educators who carry out these policies are simply "not aware" of the racially repressive effects of practices such as standardized testing, ability grouping, racially segregated schools, and teacher testing. Or, perhaps the simple ignorance is one of "not knowing" what behaviors and policies constitute racism. The simple ignorance explanations are not credible, however. To accept them, one has to believe that legislators do not engage in fact-finding or study the issues and that state education officials, teachers, and teacher educators do not study their professions sufficiently to have discovered the enormous bodies of research literature that show the racially repressive effects of each of these practices. No, teacher testing and other repressive practices continue to thrive because racism continues to thrive in America. No one, of course, believes that in every township and city of America small conspiratorial groups of policy makers assemble in secret meetings to say, "Let's implement this or that policy so we can lock out African Americans, Hispanics, or this or that group;" but neither are policy makers blind to the existence of institutionalized racism and its deadly effects. They are well aware in these modern times that the broad blanket of institutionalized racism is worn as a cloak to obscure not only individual racism, but also individual responsibility to correct racism.

The motivation for continuing teacher testing must be examined by an intelligent, informed profession in the broader context of institutionalized racism. Sizemore (1986) illustrates racism with the African-American struggle for a fair share of the power and suggests that head-on confrontation may be necessary to jar loose the power structure that continues to defend policies and practices that result in inequality:

Racism has two forms: individual and institutional. The former is one person's personal dedication to the conviction and the latter exists when the conviction is legitimized by laws, rules, regulations, standards, custom, and tradition. Racism is a powerful political weapon which creates a situation of privilege for those in the master race and gives them protection from the competition of certain groups for scarce resources, such as jobs, housing, and education. Politics is the management of the conflict which occurs when groups war over these scarce resources. The prevailing concept in politics is power or the ability to make someone do something when he or she does not want to do it. Throughout the history of Blacks in the United States, their advancement has rested on (1) economic prosperity, that is there's a surplus of jobs and resources, in other words, more jobs and resources than White folk need; or (2) non-violent direct action, such as civil disobedience, and violence, like riots, arson, and those kinds of thing. Now Blackwell notes that we need a return to the use of direct action and political pressure to combat the negative effect of Reagan and the National Conservative climate of the Second Jim Crow period. (pp. 11-12)

When one considers the historical, cyclical concerns regarding minority teacher's "competence" (Dilworth 1984), previous assaults on the minority teaching force, such as the displacement of minority educators during the early years of integration (Ethridge 1979), the use of technically indefensible selection and certification instruments (Haertel 1987; Haney, Madaus, & Krietzer 1987), there are good reasons to be suspicious of the motivations underlying the teacher competency testing movement. It becomes difficult not to see teacher testing as a small piece of the larger web of institutional racism that continues to obstruct democracy in America.

On the other hand, advocates of testing continue to claim that the testing of teachers has "nothing to do with racism," rather it is necessary to assure quality after well over a decade of teacher testing and the continuing cries about declining educational effectiveness in the schools. The quality argument, however, is losing its original credibility. As has been pointed out earlier, most of these southern and border states remained for over fifteen years and probably still should be under federal mandate to desegregate their institutions of higher education. This fact and accompanying data that show most of these states cont-inue to fall in the bottom half of the nation in average per pupil expenditure and teacher salaries (Carnegie Foundation 1988) make the quality argument ring hollow. Whether there has been any real concern for quality education elsewhere in the nation is equally as

questionable in light of reduced social and educational expenditures and increased military expenditures at the federal level during the 1980s (Edelman 1987).

The quality argument may make sense to a public that is not well informed about the limitations of pencil-paper testing, but those who study their profession—professors of education, teachers, school leaders, and state department officials—are obliged to know better. Research in the areas of admission testing for teacher education and certification testing clearly tells us two things: (1) that scores on such examinations are not sufficiently correlated to any known level of teaching competence in the classroom to tell us who will or will not be good teachers and (2) that such tests have a disproportionate impact on minority candidates. A considerable body of literature in the area of tests and measurement tells us that pencil-paper, standardized examinations are not very useful methods to identify talent among most nonmainstream linguistic, racial, cultural, and economically poor groups. This body of research literature also tells us that there are more unanswered questions than answered questions about whether or not standardized examinations can actually be used beneficially in societies that are as racially and culturally heterogeneous as is America (O'Conner 1989; Moore 1989; Valdes 1989; Tsang 1989; Kochman 1989; Maker & Schiever 1989). In fact, there is a growing awareness that the concept of standardization presents a counterproductive paradox in a society that celebrates its diversity and individuality.

Let us assume that those who defend teacher testing in the collective profession—teacher educators, teachers, educational leaders and policy makers—have studied these bodies of literature that question standardized testing. Let us assume that they have a historical sense of prior attempts to prevent people of color from attaining professional roles in the teaching profession. Let us assume that they have studied the literature on the validity of teacher tests. Let us also assume that they have some knowledge about policy analysis through the lenses of conflict and critical theory. Against the backdrop of these assumptions, advocates of testing are obliged to answer the question: Why is teacher testing defended so tenaciously? Is it simple ignorance, or is it racism?

Appendix

Table 1. States Mandating Competency Assessment of Teachers in 1986

State	Mandate		Date	Level		Skills Tested				Type of Tests	
	Legislative	*St. Bd. of Educ.*	*Mandated / Implemented*	*Admissions*	*Certification*	*Basic*	*Professional*	*Academic*	*On-the-Job*	*National Standard*	*Customized*
Alabama		x	80 / 81	x	x	x	x	x		ACT / SAT	x
Arizona	x	x	80 / 81	x	x	x	x			PPST	x
Arkansas	x	x	79 / 83		x	x	x	x		NTE	x
California	x		81 / 83	x	x	x		x		CBEST / NTE	x
Colorado	x		81 / 83	x	x	x				CAT	
Connecticut	x	x	82-85 / 83-87	x	x	x	x	x			x
Delaware		x	82 / 83		x	x				PPST	
Florida	x		78 / 80	x	x	x	x		x		x
Georgia		x	75 / 78		x		x	x	x		x
Hawaii		x	84 / 86		x	x	x	x		NTE	
Illinois	x		85 / 86-88	x	x	x					x
Indiana	x		84 / 85	x	x	x	x	x		NTE	x
Kansas	x		84 / 86		x	x	x			PPST / NTE	
Kentucky	x	x	82 / 83-85	x	x	x	x	x	x	NTE	
Louisiana	x		77 / 78		x	x	x	x		NTE	
Maine	x		84 / 88		x	x	x	x		NTE	
Maryland		x	86 / 87		x	x	x	x		NTE	
Mass.		x	79 / 82		x	x	x	x			x
Minnesota	x		85 / 88			x		x		NTE	

Table 1. *continued*

Mississippi	x	x	82 / 86	x	x	x	x	x	x	NTE	x
Missouri		x	81 / 85	x		x				ACT / SAT	
Montana		x	85 / 86		x	x	x	x		NTE	
Nebraska	x		84 / 86	x		x				PPST	
Nevada		x	84 / 86	x	x	x		x	x	?	?
N. Hampshire		x	84 / 85		x	x				PPST	
New Jersey		x	84 / 85		x	x		x		NTE	
New Mexico	x	x	81 / 83	x	x	x	x	x		NTE	
New York		x	84 / 84		x	x	x		x	NTE	
N. Carolina		x	79 / 82	x	x	x	x	x	x	NTE	
North Dakota		x	86 /	x	x	x	x	x		?	?
Ohio		x	85 / 87	x	x	x	x	x			
Oklahoma	x		80 / 82		x	x	x	x	x		x
Oregon		x	82 / 85	x	x	x				CAT	
Pennsylvania		x	84 / 87		x	x	x	x	x	?	?
Rhode Island		x	82 / 86		x	x	x			NTE	
S. Carolina	x		79 / 83	x	x	x	x	x	x	NTE	
South Dakota		x	85 / 86		x	x	x	x	x	NTE	
Tennessee		x	79 / 79	x	x	x	x	x		PPST / NTE	
Texas	x		81 / 84-86	x	x	x	x	x	x	PPST	x
Utah		x	79 / 80	x		x				?	?
Vermont		x	80 / 82		x		x	x	x		x
Virginia	x		80 / 85		x	x	x	x	x	NTE	x
Washington		x	78 / 83-87	x	x	x	x				x
West Virginia		x	82 / 85		x	x	x	x		?	?
Wisconsin		x	86 / 87	x	x	x		x		?	?
Wyoming		x	82 / 82	x	x	x				CAT	
Totals - 46	20	32		25	41	44	32	31	14	31	16

Note: From "State Assessment Trends" by J.T. Sandefur, August, 1986, *AACTE Briefs*, 13.

Table 2. Teacher Competency Test Passing Rates by Ethnicity for Nineteen States

State	Passing Rates by Percent						Test
	Angles	*Asians*	*Blacks*	*Hispanics*	*Native Americans*	*All*	
Alabama	86		43			81	AITCT (NES)
Arizona	73	37	31	40	20	65	ATPE
Arkansas	88		33			82	NTE (ETS)
California	76	50	26	39/40/38[1]	67	68	CBEST (ETS)
Connecticut	56	42	31	30	75	55	CONNCEPT
Florida	89	55	37	53	70	82	FTCE
Georgia	87		35			78	CRTCT (NES)
Louisiana	76		15			77	NTE (ETS)
Mississippi	72		33			63	COMP (ACT)
	97-100[2]		54-70[2]			NA	NTE (ETS)
New Jersey	92	53/71[3]	53/71[3]	53/71[3]		87/89	NTE (ETS)
New Mexico							
Admission	71		51			63	Vary by school
Communication							
Skills	96		83	55		92	NTE (ETS)
General							
Knowledge	94		65	72	52	88	
Professional							
Knowledge	99		98	97	91	99	
New York							
Communication							
Skills	86	40	49	75/42/49[1]	69	81	NTE (ETS)
General							
Knowledge	80	59	42	33/36/42[1]	77	75	
Professional							
Knowledge	89	64	60	83/51/50[1]	83	87	

Table 2. *continued*

North Carolina *Professional Knowledge*	91		36			80	NTE (ETS)
Oklahoma	77	77	47	65	67	76	OTCT (NES)
Oregon	81	74	34	45/83/66[1]	64	80	CBEST (ETS)
South Carolina[2]	74		18			70	SCEEE
Tennessee[2]	96		94			95	NTE (ETS)
Texas	81	57[4]	32	47	57[4]	75	PPST (ETS)
Virginia[2]	93		41			95	NTE (ETS)

1. In the California, New York, and Oregon data the first passing rate is for Mexican Americans, the second passing rate is for Puerto Ricans, and the third is for Hispanic and other Latin American candidates.

2. Passing rates at predominantly White and Black public institutions.

3. All racial/ethnic groups are reported in a combined "Minority" category in the New Jersey reporting system. The first passing rate is for the General Knowledge test required for elementary certification; the second passing rate is four Subject Area tests required for secondary certification.

4. Asian, Native American, and other minority candidates are reported in a combined "Other" category in the Texas reporting system.

Note: ETS = Educational Testing Service, NES = National Evaluation Systems, Inc., ACT = American College Testing. Passing rates are for first time takers only, with the exception of cumulative passing rates for Texas. Passing rates were compiled by G. Pritchy Smith from data collected for *The Effects of Competency Testing on the Supply of Minority Teachers*, a study sponsored by the National Education Association and the Council of Chief State School Officers.

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11

The Impact of Standardized Testing on Children of Color

Gina R. Dyer

The questions and claims regarding the bias of standardized tests in the evaluation of children of color have been the focal point of research and legal cases for many years. Despite research and legal decisions, still there is no general consensus. Are standardized tests inherently biased? Are many of the children of color lower in ability? If the answers to these questions are "No," then what factors influence the performance of these children on standardized tests?

History of Assessment

Assessment has a long history. According to Bowman (1989), 2,000 years ago the Chinese developed civil service exams (cited in French & Hale 1990) and Socrates was an advocate of combining testing and teaching. The origin of American assessment practices can be traced to Europe. The early psychologists were interested in discovering "general laws to account for human behavior" (French & Hale 1990, p.4). Individual differences in human sensation and perception were studied by James McKeen Cattell and Whilhelm Wundt in Germany. In England, Darwin, Wallace, Huxley, and Spencer studied the heritability of physical characteristics. Sir Frances Galton became interested in extending this research to the inheritance of mental abilities.

When Cattell established a psychological laboratory at Columbia University in 1891, he brought his European influences to America. Most early experimentation in America with mental functioning dealt with measurement of physical differences and attributes. Bolton, in 1891, developed and used a test requiring children to remember arithmetic digits; and, in 1897, Ebbinghaus invented a completion test. At this same time in Europe, Binet began to develop tests that broke from traditional sensory tasks (French & Hale 1990).

Assessment was revolutionalized by Binet in his search to develop a method to diagnose mentally retarded children in France. In 1911, Henry Goddard and Elizabeth Kite translated Binet's scale into English. This version was used extensively in the United States until Terman's Stanford revision in 1916. It was Terman who coined the phrase *intelligence quotient*. Terman multiplied William Stern's *mental quotient* (chronological age/mental age) by 100 (French & Hale 1990).

At the beginning of the twentieth century, there were 10 factors that directly influenced the testing movement: (1) massive immigration to the United States; (2) urbanization; (3) the increasing influence of science; (4) the progressive educational movement; (5) testing of World War I inductees; (6) the perceived utility of the Army tests; (7) the putative empirical relation between race and IQ; (8) strict school attendance laws; (9) child labor legislation; and (10) the belief in a competitive; meritocratic society (Marks 1976-77; Fass 1980, as cited in French & Hale 1990). It fell to the schools to turn the children of immigrants into Americans, and it was believed that the use of mental tests would help the schools cope with the task of educating so many culturally diverse children. These early tests were successful in predicting academic achievement (French & Hale 1990); however,an Army report alleging differences in mental ability between Blacks and Whites, as well as American born inductees and inductees from Eastern Europe, was to have an impact on the future assessment of children of color. The racial interpretation of this report captured public attention and the fact that these differences were based on "inadequate statistical procedures and analysis" was ignored (French & Hale 1990, p.11). Through the influence of the prejudicial writings of Terman and Goddard, the original intent of Binet—that of identifying and helping special children—was changed to a system of rank-ordering children (French & Hale 1990).

Change in American education required legal action. One landmark action was *Brown v. Board of Education* (1954) in which segregated schools were deemed constitutionally not permissible. In the decade following this decision, some schools used intelligence and achievement test results to maintain a segregated system. The most influential case addressing this issue was *Hobson v. Hanson* (1967). The court ruled against the schools' use of tests to place children into academic tracks and ruled that the standardized group aptitude tests were not valid for use with Black children because these tests were standardized on

White middle-class children. This notion of standardization became the first legal definition of test bias (Sandoval & Irvin 1990).

Two important cases on the use of intelligence tests with children of color are: *Larry P. v. Riles* (1979) and *Parents in Action on Special Education (PASE) v. Hannon* (1980). The issue in these cases was to determine whether intelligence tests were to blame for the disproportionate placement of Black children into classes for the educable mentally retarded. Judge Peckham in the *Larry P.* case ruled that intelligence tests should not be used with Black children. Judge Grady in *PASE v. Hannon* ruled for the use of standardized intelligence tests (Sattler 1988; Sandoval & Irvin 1990); as a result of these cases, two principles have been codified: "Tests must be validated for the specific purpose for which they are used and should not be discriminatory" (Sandoval & Irvin 1990, p. 91).

Similar cases were brought on behalf of Hispanic children. *Diana v. the State Board of Education* (1970) determined that nonverbal tests would be used mainly to assess the cognitive skills of linguistically "different" children. This ruling also determined that these children would be assessed in their primary language and English, and that an interpreter would be provided if the examiner was not bilingual (Sattler 1988). In *Guadelupe v. Tempe Elementary School District* (1972). It was ruled that Hispanic children could be placed in classes for the educable mentally retarded only if they were tested in their own language, scored two standard deviations below the population mean on an approved intelligence test, and if the school used other assessment procedures, and obtained permission from parents for such placement (Sattler 1988).

The complaints against using intelligence tests in placing ethnic minority children will continue, as will support for the use of these tests in placement decisions. Each side in this issue must be considered if intelligent decisions as to the use of intelligence tests with African American, Asian American, Hispanic, and Native American children —in fact all children—are to be made.

Arguments Against Use of Intelligence Tests

Sattler (1988) gave five major arguments against the use of intelligence tests with ethnic minority children. These arguments included: (1) intelligence tests are culturally biased, (2) national norms are not

appropriate for children of color, (3) children of color are handicapped in test taking skills, (4) test scores of children of color are depressed because examiners are White, and (5) testing leads to inadequate and inferior education.

The first argument against the use of intelligence testing with children of color is that these tests are culturally biased. There are many definitions of *bias* in testing, but to define *bias* the meaning of the test score should be considered. Is the test score a predictor of future achievement or a measure of what has been learned to date (Sattler 1988)? Valdez and Valdez (1983) concluded that the use of conventional methods for the detection of predictive bias were inappropriate for use with Hispanic children, since these methods were too insensitive to detect predictive bias. Other facets of the cultural bias argument are that intelligence tests are not relevant to the experiences of children of color and that these tasks are invalid because these children have not had the same experiences as have White middle-class children. Overinterpretation of results can also play a part in bias, if the examiner generalizes from the limited domain of the test to the broad range of ability (Sattler 1988). Duffey, Salvia, Tucker, and Ysseldyke (1981) described *biased assessment* as constant error in decisions, predictions, and inferences about members of a particular group (as cited in Johnson, Vickers, & Williams 1987). Tests are considered culturally biased if children have not been exposed to the material involved in the test questions and if the tests are geared toward White middle-class students (Reynolds & Kaiser 1990). Rueda, Cardoza, Mercer, and Carpenter (1984) stated that with children who are clearly not proficient in English, there is essentially nothing known about the two most prevalent methods of evaluating their intelligence: use of nonverbal intelligence tests or the use of an interpreter (cited in Figueroa 1990).

A second argument against intelligence testing is that national norms are inappropriate for most children of color. Mercer (1976) advocates the establishment of pluralistic norms, as these norms are useful in comparing children's performance to that of their own ethnic group (cited in Sattler 1988). Mercer (1978-79) stated that "the greater the socio-cultural distance between the individual and the dominant core culture, the lower his or her score will be" (cited in Jirsa 1983, p.13). In evaluating children of color, it is important to recognize the norms that are used and why these norms were selected (Sattler 1988).

The third argument against using intelligence tests with African American, Asian American, Hispanic, and Native American children is that the children may not have sufficient test-taking skills and problem-solving strategies and may exhibit test anxiety. These children may not have been exposed to test material and may respond incorrectly even though they have an adequate storage and retrieval system. Other children of color, such as Native American children, may not desire to compete with others and therefore may not work quickly on timed tests. There is also evidence that some children of color have limited test-taking skills, but this is also true of White children. More research is needed to determine just how pervasive this limitation is among some African American, Asian American, Hispanic, Native American, and White children (Sattler 1988).

Some psychologists believe that the intelligence test performance of children of color is impaired when they are evaluated by White examiners. There may be communication difficulties as psychologists primarily speak standard English and are unable to communicate effectively with children of color. Some researchers believe that lowered test scores are not due to lowered ability, but are caused by difficulty in communicating (Reynolds & Kaiser 1990); latent prejudice; anxiety and fear; stereotypic views; and the misunderstanding of customs and values that interferes with rapport building and the evaluation process (Sattler 1988).

The greatest argument against the use of intelligence tests with children of color is that the results of these tests are used to place these children in special education classes or tracks which are considered inadequate and inferior. One premise to this argument is that Black children placed in special classes would achieve at a higher level if still in the regular class. Another premise is that test results produce negative expectancies in teachers and change the way teachers treat these students. Williams (1983) believed that tracking leads to ethnic and socioeconomic separation and reinforces the stereotypic view that African Americans, Hispanics, and Native Americans are inherently intellectual inferiors.

These arguments against the use of intelligence tests with children of color have been the catalyst for much research. Overall, the results of this research have been positive, giving support for the use of these tests in the evaluation of children of color.

Support For the Use of Intelligence Tests

While the arguments against using intelligence tests with children of color deserve consideration, many researchers believe that the arguments about these tests are culturally biased have little merit and that there are many reasons to use intelligence tests in the assessment of children of color.

One argument is that intelligence tests are useful in the evaluation of a child's present functioning. Sattler (1988) viewed intelligence test scores as useful indices of current cognitive strengths and weaknesses and also as aids in evaluating change and progress. Hennessy and Merrifield (1976) reported highly similar structures of mental abilities in African American, Hispanic, Jewish, and White high school students (cited in Sattler 1988). Their findings suggest that intelligence and achievement tests measure the same abilities in these ethnic groups.

Another argument in support of using intelligence tests is that these tests are good indicators of future academic success and performance as defined by the majority culture (Sattler 1988). Kaufman, Harrison, and Ittenbach (1990) state that the predictive validity data of the WISC-R indicates that it is equally effective for Whites and students of color in predicting school success. Beckum (1983) believed that test information should be used as a diagnostic tool to help point out skill development needs and to design an instructional plan to help children attain their goals.

A third argument for the use of intelligence tests is that of obtaining appropriate services to which all children are legally entitled. The problem of poor achievement by many children of color has not been caused by tests. It is the tests which document the severity of educational problems of children of color, as well as for other children (Sattler 1988). To provide nondiscriminatory assessment and services for children of color, it is important to separately validate intelligence measures for various ethnic and linguistic groups (Jenson 1980; Kaufman 1979; Valencia 1982, cited in Matazow; Kamphaus, Stanton, & Reynolds 1991). Green (1978) noted, "The tests are not bigoted villains but colorblind measuring instruments that have demonstrated a social problem to be solved" (cited in Sattler 1988, p. 573).

A fourth argument for using intelligence tests is the value of these tests in evaluating the outcomes of school and special programs, in determining if children have learned to read or perform arithmetical

operations, and in providing objective evidence of school accountability. Eliminating the tests would release the educational system from any accountability (Sattler 1988). Beckum (1983) viewed group tests as aiding school staff in making decisions about the effectiveness of the school's programs, identifying individual academic problems, and prescribing remediation for improvement of academic skills. Herman and Dorr-Bremme (1983) noted that group tests seem to contribute most to decisions about curriculum evaluation.

Tests can also be useful in revealing inequalities of available opportunity and may stimulate special intervention to maximize each child's potential. Dunn's (1968) research directed attention to the disproportionate representation of children of color in classes for the mildly mentally retarded (cited in Chinn & Hughes 1987). Since 1968, the Office of Civil Rights (OCR) has surveyed schools regarding student enrollment and placement. In 1979, the OCR established the Panel on Selection and Placement of Students for the Mentally Retarded to identify factors that might account for overrepresentation of children of color in classes for the mildly mentally retarded and to develop procedures for remedying the imbalance. While students of color are still overrepresented in special education classes, the numbers are decreasing: "What remains uncertain is the extent to which minority children have been appropriately referred, diagnosed, and placed" (Chinn & Hughes 1987, p. 45).

A final argument in support of the use of intelligence tests is that these tests: provide students with an alternate means of demonstrating academic ability; provide a measure that is comparable across schools and time; and constitute an objective, rather than prejudicial standard, of competence and potential (Sattler 1988). In psychometric literature on intelligence, culture is insignificant (Sandoval 1979; Sandoval, Zimmerman, & Woo 1980; Sattler 1982, cited in Figueroa 1990). No cultural impact was detected in reliabilities, validities, or factorial structures in almost all scientific literature on intelligence tests in the United States. The literature on intelligence tests finds non-U.S. cultural variance in test scores to be negligible and that cultural bias in these tests has yet to be proven from an empirical, psychometric perspective (Figueroa 1990).

Overall, research supports the use of intelligence tests with children of color; however, there will continue to be arguments against the use of these tests with children of color as long as these children score

lower than their White counterparts. It is important to set standards of practice that ensure an unbiased assessment of these children, and it is equally important to determine factors that impact on their performance.

Again the question arises. If standardized tests are not inherently biased, are children of color less able than their White counterparts or are other factors impinging on their performance?

Chinn and Hughes (1987) believed that several areas warrant further investigation in the search for reasons for the proportionately higher percentages of Blacks in special education classes. These include: examination of the relationship between social variables, such as socioeconomic status and special class placement; poverty's contribution to the development of learning problems; and the need for appropriate training of personnel to adequately identify and work with these students. Sluzki (1979) viewed recent immigration status and language problems as additional stressors for those who must cope with adjustment to a new culture simultaneously with the loss of their native land and culture (cited in Gibbs & Huang 1989).

Stein (1990) says that language is seen as an underlying cause for poor achievement of children of color. Socioeconomic status is another factor. Wilen and Sweeting (1986) see bilingualism as a complex process and frequently psychologists and teachers assume that students are bilingual when, in fact, they are not proficient in either language. Often a Hispanic student will have difficulty learning English because of inadequately developed skills and concepts in Spanish.

In 1968, the U.S. government defined the problem of low achievement of students of color as poverty. Learning English has not remedied this problem. The solution according to Stein (1990) is the opportunity to enter the wider society and economy. Sattler (1988) viewed poor children as having adaptive strategies that are not conducive to good test performance. Often these children cope poorly with external pressures because they feel things happen to them without their participation. Cox (1983) used the term *cumulative deficit* to describe the poor performance of children of color (cited in Sattler 1988). Cox believed that poverty deprives these children of enriching cognitive experiences and makes them less able to profit from environmental stimulation.

Hebb (1971) viewed prejudice as having a cumulative effect over generations. Children of color, not only experience prejudice, but are reared by parents who feel defeated by it. The lack of toys, books, and parents with time to talk is a direct effect of poverty. Hebb believed that this direct effect is multiplied by an environment without hope (cited in Sattler 1988).

Research suggests several factors that could contribute to poor test performance are: poverty, language deficits, prejudice, and recent immigration status. These factors must be considered when evaluating children of color. However, the question still remains as to how to best evaluate these children.

Recommended Practices in Assessing Children of Color

In 1975, Congress passed Public Law 94-142, which reaffirmed and expanded earlier mandates concerning nondiscriminatory evaluation (Bersoff & Hofer 1990), and which includes a section on native language. In this section, *native language*, "when used with reference to a person of limited English speaking ability, means the language normally used by the person, or in the case of a child, the language normally used by the parents of the child" (Gutkin & Reynolds 1990, p. 1030).

Section 300.532 sets minimum guidelines for evaluation: (1) tests and other evaluation materials should be administered in the child's native language or other mode of communication, be validated for the specific purpose for which they are being used, and be administered by personnel trained in their use in conformance with standard procedures; (2) evaluation materials should include tests to assess specific areas of educational need, not only those designed to provide a general intelligence quotient; (3) tests are to be selected to best ensure that their results best reflect the child's aptitude or achievement level; (4) no single procedure can be used to determine appropriate educational placement; (5) evaluation of children should be made by a multidisciplinary team; (6) parents should be informed about their child's placement in their primary language; and (7) parental consent must be obtained before the child is placed or records released (Gutkin & Reynolds 1990, p. 1030).

Sattler (1988) added some recommendations for the assessment of children of color. First, make the child feel as comfortable as possible, with rapport established before beginning assessment procedures. Choose tests carefully, using a multimethod approach. In the testing of children who speak a language other than English in the home, first determine the child's preferred language. Then administer a language test in the language spoken by the child with the addition of a nonlanguage performance scale. Naglieri and Prewett (1990) stated that the nonverbal portion of a major intelligence test may be a better indication of general intellectual ability as it circumvents the language difficulties of the child. Bilingual children should be administered intelligence tests in both languages. Standardized test results should be supplemented with information from observations, interviews, self-reports, work samples, and anecdotal information (Sattler 1988).

An examiner should include the child's extended family in gathering information about the child and in interpreting test results. Interpretation should be flexible and recognize that some principles of interpretation may not apply to all groups. It is also important to ascertain the child's degree of acculturation.

Another important consideration would be for the examiner to recognize any personal, preconceived images about the child's ethnic group and take steps to ensure that these images do not interfere with assessment procedures. The examiner should learn as much as possible about the different ethnic groups, their culture, group preferences, and each group's viewpoint in order to provide children equal opportunities to achieve to the limits of their capacities. Williams (1983) believes that the educational community should focus on achievement rather than aptitude testing or modify assessment techniques and interpretive procedures as a means of eliminating unfair placement practices.

Other often recommended practices include the use of translations of existing tests and the use of interpreters (Wilen & Sweeting 1986). Problems arise with the use of test translations, as these tests inherently require bilingual skills from examiners; and norming samples are limited, unknown, or from other countries (Figueroa 1990). Other problems in the use of test translations include: differing levels of difficulty between vocabulary items in English and other languages,

multiple acceptable responses depending on the country or region of origin, and the children's lack of ability to read or write the language they speak (Wilen & Sweeting 1986). Effective interpreters must be trained in assessment protocol: utilization of standardization procedures, refraining from nonverbal gestures, the importance of objectivity, and the precise observation and recording of the child's verbal and nonverbal behavior (Wilen & Sweeting 1986). The problem with interpreters arises from the difficulty in translating concepts, as they may lose their meaning in translation. Another problem with the use of interpreters is that tests were validated for certain procedures and the interruption caused by translation nullifies the validation (Chinn 1980).

Chinn (1980) believed that the following issues stand out in the definition of appropriate procedures for assessing children of color and making decisions regarding educational placement of these children: (1) testing should address children's linguistic and sociocultural background and not discriminate; (2) children's adaptive behavior outside the public school should be assessed; (3) children have the right to be tested in their primary language; and (4) children and their guardians have the right to due process procedures when placement decisions are being made.

In summary, assessment of children of color requires planning, thought, and consideration. The examiners need to consider their own attitudes toward the child's ethnic group and understand the needs and preferences of that group. Assessment tools should be chosen carefully and include the following: observations, work samples, adaptive behavior measures, nonverbal measures, language tests in English and the child's primary language, use of translated tests where appropriate, and interpreters, when their aid will facilitate and not invalidate test procedures.

Perhaps, Sattler (1988) stated it best: "We need to strive to eliminate social inequalities and prejudice from our society. Rather than attack intelligence and other ability tests, we should focus on the environmental problems that have created the intellectual and academic disparities. Improving the quality of education and changing attitudes toward learning in the home may go a long way toward improving test scores and changing attitudes toward testing" (p. 591).

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Part IV:
Family and Societal Influences on Multiculturalism

12

Mathematical Empowerment and African American Families

Marilyn Strutchens

It has been 37 years since the *Brown v. Board of Education of Topeka* court decision declared that "separate but equal" school facilities were inherently unequal and ultimately ordered the desegregation of American schools (Mosteller & Moynihan 1972). Part of the court's decision was based on its view that segregated schools damaged African American students' achievement by adversely affecting their motivation to learn (Cohen, Pettigrew, & Riley 1972).

But, today many African American students are attending desegregated schools, and their achievement levels are still substantially lower than their White American counterparts, especially in mathematics. Mathematical achievement is of particular importance since we are living in a highly technological society which demands that its citizens be mathematically literate. Of Americans who receive bachelor's, master's, and doctoral degrees in the physical sciences (including mathematics, physics, and engineering), only 5% are African Americans, Hispanics, and Native Americans (National Research Council 1989). Also, according to the National Research Council (1989), during the last 15 years, the total number of African Americans and Hispanics receiving doctoral degrees in the mathematical sciences has averaged less than 10 annually. These statistics indicate that there is a serious problem in the mathematical achievement and participation of African American students in mathematics.

Furthermore, reports (Anick, Carpenter, & Smith 1981; Burton & Jones 1982; Jones, Burton, & Davenport 1984; Matthews *et al.* 1984; Matthews 1984; Reyes & Stanic 1988) analyzing National Assessment of Educational Progress (NAEP) data over the past 13 years have indicated that, even though African American students' mathematical achievement has improved significantly from 1977 to 1986, African American students' mathematical achievement has been consistently several percentage points below White American students' achieve-

ment. Thus, African American students' mathematical achievement must continue to improve.

In order to aid in the improvement of the mathematical achievement of African American students, mathematics educators, educational psychologists, and other researchers have been studying African American students' performances and attitudes related to mathematics to find possible reasons and solutions for their underachievement and consequent underrepresentation in mathematics. As a result, many factors have been considered as reasons for the underachievement and underrepresentation of African American students in mathematics. This chapter briefly discusses some of those factors and focuses on parental involvement as a major factor in the mathematical achievement of African American students.

Factors Affecting the Mathematical Achievement of African American Students

General theories related to the achievement of African Americans. One of the oldest debates associated with African American achievement is *environment versus heredity.* This debate began in the 1960s when psychologists were trying to determine what causes intelligence tests scores to vary among people. Environmentalists believe that environmental factors are the major determinants of one's intellectual ability (Jencks 1972; Jensen 1969; Ornstein & Levine 1984). On the other hand, hereditarians believe that intelligence is determined primarily by heredity (Jensen 1969). However, modern theoretical positions tend to view the development of behavior as a synthesis of heredity and environment, each indispensable to the attainment of normal patterns of behavior (Greenough 1973). Hereditarian and environmentalist theories have been characterized as "cognitive deficit" theories and have been considered invalid by some (Ginsburg 1986).

Other theories relating to the underachievement of African American students are John Ogbu's caste system and Wade Boykin's triple quandary. Ogbu (1986) contended that African Americans belong to a category which he calls "castelike:" "Castelike minorities are those who are incorporated into this country more or less involuntarily and permanently and then relegated to menial positions through legal

and extralegal devices" (Ogbu 1986, p. 27). As a result, castelike minorities often develop what Ogbu calls an "institutionalized discrimination perspective" (Ogbu & Matute-Bianchi 1986, p. 93). Members of this group tend to believe that it is difficult for them to advance into the mainstream or achieve middle-class positions or self-betterment through individual efforts in school or by behaving like members of the dominant group. Thus, castelike minorities believe that their chances are better through collective efforts and manipulating the system.

Boykin (1986) asserted that African Americans are in a triple quandary which affects their performance in school and in other aspects of life. According to Boykin, African Americans are constantly involved in conflicts which evolve from their existence in three realms of negotiation: incomplete socialization to the European American cultural system, victimization by ethnic and economic oppression, and participation in a culture that is sharply at odds with mainstream ideology. Being in a state of "triple quandary" as defined by Boykin may be a viable explanation for the school failure of some African American students because many of them refuse to conform to the rules, regulations, and protocols of the school environment which are designed to acculturate students into the mainstream society.

Another factor which has been identified as a possible reason for the underachievement of African American students is their cognitive style (Anderson 1988; Banks 1988; Cohen 1969; Grant 1989; Oakes 1990; Secada 1989; Shade 1982; and Stiff 1990). "Cognitive style characterizes different individuals' ways of processing information" (Saracho 1988, p. 1). Moreover, the differences in the way individuals process information are influenced by affective and environmental preferences that the individual brings into the learning environment (Keefe & Ferrell 1990).

According to Hilliard (1976), African American people (1) tend to view things in their environment in entirety rather than in isolated parts; (2) prefer intuitive rather than deductive reasoning; (3) approximate concepts of space, number, and time rather than aiming at exactness or complete accuracy; (4) prefer to attend to people stimuli rather than nonsocial or object stimuli; and (5) rely on nonverbal, as well as verbal, communication. He asserted that the reason for these differences is found within African American culture (Hilliard 1976).

Thus, the African American cognitive style correlates directly with their culture . In contrast, Shade (1982) reported that theorists have found that students in the educational enterprise are most successful if their information processing enables them to focus on the task itself, rather than on the people in the situation; to separate ideas and concepts into parts and reweave them into a unified whole; to abstract both obvious and nonobvious attributes that seemingly link things, ideas, or principles; to extract important information embedded in distracting influences; to concentrate on something for a prolonged period of time; to attend to verbal cues rather than nonverbal cues; to reflect in problem solving; and to reason logically and abstractly.

Cohen (1969) suggested that this pattern represents a psychologically differentiated cognitive style that is beneficial in a school setting, is reinforced by the content of school curricula, questions, and solutions desired on achievement and intelligence tests, and is promoted by the use of current teaching methods. Consequentially, many African American students may possess a cognitive style which conflicts with the typical cognitive style required in most educational settings and therefore may be underachieving due to their cognitive style.

Factors related specifically to the mathematical achievement of African Americans. The backbone of the problem of underachievement and underrepresentation of African Americans in mathematics is that the number of African Americans enrolling in higher level mathematics courses (algebra, geometry, trigonometry, and calculus) is relatively low. In fact, Lucy Sells (1978) stated that unknown numbers of young women and many African Americans, Hispanics, and Native Americans become victims of the invisible "mathematics filter" by not enrolling in higher level mathematics courses in high school. According to Sells (1978), victims of the mathematics filter lose access to undergraduate majors in mathematics and natural sciences and hence to related career opportunities.

Part of African American students' failure to enroll in higher level mathematics classes can be attributed to insufficient career guidance and encouragement from school adults (Oakes 1990). Also, many poor African Americans and other children of poverty often receive substandard instruction after they have enrolled in higher level math-

ematics courses and tend not to pursue careers related to mathematics (Oakes 1990).

Another factor which has been identified as an influence affecting students' achievement and their decisions to enroll in mathematics is students' attitudes toward mathematics. Examples of student attitudes are confidence in learning mathematics and perceived utility of mathematics (Johnson 1984; Matthews 1984; Reyes and Stanic 1988). These factors are labeled affective influences because they are determined by student beliefs, attitudes, and emotions about mathematics and about oneself as a learner of mathematics (Hart 1989; Reyes 1980).

Research indicates that attitudes or feelings about mathematics are important factors in student decisions (Reyes 1980). Furthermore, since student decisions about enrollment in mathematics courses are important ones and student attitudes toward mathematics affect these decisions, an understanding of these attitudes toward mathematics is essential (Reyes 1980).

Confidence in one's ability to do mathematics is one of the most widely studied attitudes related to mathematics. In fact, Oakes (1990) cited several studies (Matthews 1980; Rendon 1983; Wylie 1963) which indicated that African Americans and Hispanics have lower levels of confidence in their mathematical abilities than do their White American peers. This is particularly important since teachers tend to interact more with students who have high confidence in their ability to do mathematics (Reyes 1980).

Another important factor affecting achievement in the affective domain is the African American student peer group. Jawanza Kunjufu (1988) found this to be true in a study in which he investigated the effects of peer pressure on school achievement. He found that several students who had previously done well in school were achieving significantly below their ability level due to peer pressure. Many of the students found that if they studied and did well in school, their African American peers called them "nerds," accused them of acting "White," and ostracized them. Thus, they opted to be popular rather than smart. This pressure affects the achievement level of African American students in mathematics because some African American students tend to take lower level mathematics courses or do not excel in higher level courses in order to be accepted by their peers.

Other factors in the affective domain which have not been studied as deeply as ethnicity as the preceding ones are: beliefs about the appropriateness of mathematics as an area of study, attributions of success and failure in mathematics, student belief in mathematics as a White male domain, student attitudes toward other students and teachers, influence of significant others, and an absence of role models. The remainder of this chapter will address an important segment of significant others and its influence on the mathematics achievement of African Americans: parents.

African American Parental Involvement in Mathematics

Welch, Anderson, and Harris' (1982) analysis of NAEP data revealed that home and community background factors accounted for 25% of the variance in mathematics achievement of individual 17-year-olds. In like manner, Oakes (1990) listed several studies (Berryman 1983; Ekstrom *et al.* 1988; Tsai & Walberg 1983) which found that the family's socioeconomic status and parents' educational background have had large effects on students' mathematical achievement. These studies have also indicated that parents who are formally educated tend to urge their children to take courses in high school which will enable them to do well in college (Oakes 1990). Thus, one may assume that since many African American children live in poverty and in homes where their parents have not been formally educated that the disproportionate rates of underachievement and underrepresentation of African Americans in mathematics are to be expected. However, recent analysis of NAEP data would contradict this statement.

Johnson's (1989) analysis of the 1986 NAEP data revealed that "...minority students perceive that their parents expect them to do well in mathematics" (p. 146). Likewise, according to Hilliard (1987) and Irvine (1990), African American people have always viewed education as a way out of poverty. The question is, "If this is true, then why are African American students not doing well in mathematics and in school in general?"

Many former African American educators believe that desegregation of schools has actually hurt African American students more than it has helped them. This belief is based on the observation that when

schools were segregated, African American parents, community leaders, school teachers and school administrators had closer ties. These ties were important because parents and teachers worked together as partners for the education of the children. Today, African American children are suffering educationally, because in many schools the partnership between parents and schools simply does not exist. Such a partnership is important, because it helps parents to be aware of their children's school standings: Are their children taking the right courses for college preparation? Are their children being given the best opportunities to learn? Moreover, parent-teacher partnerships can help parents to take an active role in their children's education. If teachers work with parents and inform them of the happenings in their classrooms, then parents can help their children at home with homework and also help teach their children other things that may help them to be more successful in school.

Currently, many African American parents and community leaders are rarely involved in school functions. The major activities attended by these groups are parent-teacher association meetings, parent conferences, and fund raising projects. However, attending parent-teacher meetings and parent-conferences has not been beneficial for many African American parents and parents from other ethnic groups for several reasons. According to Jackson and Cooper (1989), parents who cannot speak English or cannot communicate well in groups, who may be illegal aliens, or who may be poorly educated, may realize that parent-teacher organizations and other groups exist mainly to benefit the principal and the administration, not the parents themselves. Jackson and Cooper (1989) also contended that African American parents, especially those with low incomes, and other low-income ethnic groups may need to learn parenting, language, and survival skills for urban settings. In addition, Jackson and Cooper (1989) asserted that low-income parents quickly realize that their concerns are not welcomed during parent-teacher organization meetings. Thus, change is needed in the way some African Americans interact with schools—and vice-versa—in order to improve African American students' education.

In recent years, several programs have been designed specifically to empower parents and to help increase the number of people qualified for quantitative fields. One program is *Family Math*, originat-

ing out of the University of California at Berkeley. *Family Math* is designed to bring children and their parents together to learn and enjoy mathematics in a pleasant environment in order to improve the mathematics achievement of African American, Hispanic, and Native American students (Stenmark, Thompson, & Cossey 1986). During a *Family Math* class, "parents and their children learn strategies for solving problems and how mathematics is connected to everyday life and to different careers"(Kreinberg 1989, p. 134). Moreover, parents and their children use hands-on materials to help them understand mathematics concepts (Kreinberg 1989). According to Kreinberg (1989), *Family Math* courses are usually taught by a teacher/parent team in a school, church, or community center. The courses may be given by grade levels (K-2, 3-4, 5-6, 7-9) and they usually meet for about two hours from two to six weeks. The topics taught in most classes are measurement, numbers, estimation, geometry, probability and statistics, logical thinking, patterns and functions, and algebra. Parents are given overviews of the mathematics topics covered at their children's grade levels and explanations of how the *Family Math* activities relate to these topics. *Family Math* has been successful because it is community based; the mathematics is taught in a manner that is practical and useful to the parents and their children, and it has helped the parents to become more aware of the type of mathematics their children are learning and how the mathematics will affect their children's present and future lives (Kreinberg 1989).

The Algebra Project is another program which has been successful in bridging the gap between schools and parents of color. *The Algebra Project* was initiated by Robert Moses, an African American parent who was concerned with the mathematics education of his children (Silva, Moses, Rivers, & Johnson 1990). Moses, a former secondary mathematics teacher, was invited to assist his daughter's teacher in instructing eighth grade algebra at a middle school in Cambridge, Massachusetts (Silva *et al.* 1990). Being a political activist, Moses transformed the assistance into a successful program which has enabled students who normally would not have been successful in algebra to become successful.

The Algebra Project has three major objectives (Silva *et al.* 1990). First, *The Algebra Project* "seeks to develop mathematically literate, self-competent, and motivated middle school learners who are able to

master the college preparatory high school mathematics and science curriculum and the mathematics necessary for mathematics- and science-related careers in which mathematics is a necessary tool" (Silva *et al.* 1990, p. 379). Next, *The Algebra Project* "seeks to change the way mathematics teachers construct their learning environments by producing teachers who are able to facilitate a mathematics learning environment grounded in real life experiences and to support students in the social construction of mathematics" (Silva *et al.* 1990, p. 379). Finally, the project "seeks to build a broader community of individuals including parents, community volunteers, and school administrators who understand the question of students capability as learners as a matter of effective effort" (Silva *et al.* 1990, p. 379). *The Algebra Project* helps parents to assist their children by teaching parents to raise their expectations about their children's abilities to do algebra, by teaching algebra to parents so that they are able to help their children with their homework, and by educating parents about school policies so that parents can have more of a voice in the education of their children.

Say YES to a Youngster's Future, created by the National Urban Coalition, is another intervention program designed to help schools to set excellence in mathematics and science instruction as a priority for all students (Beane 1990). *Say Yes to a Youngster's Future* also assists parents in developing an awareness of the importance of mathematics and science and the strategies for nurturing children's interest in these subjects (Beane 1990). Furthermore, *Say YES to a Youngster's Future* includes community-based facilities and persons who are willing to facilitate enrichment, especially for parents and students who have had few opportunities to discover the joys of informal explorations in science, mathematics, and technology (Beane 1990). *Say YES to a Youngster's Future* involves parents and extended family members by asking them to attend a Saturday morning program (Beane 1990), consisting of activities designed to make mathematics and science concepts more concrete for parents and their children.

The aforementioned programs have several characteristics in common: educating the parents and their children, allowing the parents to take an active role in their children's education, and bringing together a community of people to achieve a common goal. These characteristics have made these programs very effective because they have taken into consideration the cultures of the different groups

who compose school populations. Moreover, they have helped the students by empowering the parents thus enabling parents to develop skills that will not only help them to become better parents, but will also help them to become more functional as adults in a highly technological society.

Implications and Conclusions

The successes of the these intervention programs indicate that successful parent involvement includes being sensitive to the needs of the parents, listening to the concerns of low-income families, as well as middle and high-income families; involving parents in the total education of their children; and welcoming parents into the school on more than an administrative basis. Thus, school officials must continue or begin to encourage African American parents to become involved in classroom activities (observing the class, grading papers, and tutoring students). Likewise, school administrators and teachers must encourage African American parents to become involved in administrative decisions and policies which affect their children.

Moreover, African American parents must be encouraged to work with their children at home (helping with homework, asking questions that help develop thinking strategies, and spending time finding out what their children are doing in school academically and behaviorally) in order to reinforce what they are learning at school. William J. Bennett (1986) stated that "parents are their children's first and most influential teachers" (p. 126). Furthermore, Jacqueline J. Irvine (1990) asserted that African American parents' role as teachers seems to be crucial to the education of children.

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13

The Conflict Between Teacher and African American Family Questioning Patterns

Catherine Gardner
Emily Hart
Bobby Jones

The geographic distribution of populations of Hispanic Americans, African Americans, and Asian Americans continues to expand. These students bring into the classroom socio-cultural characteristics which greatly influence educational experiences. They tend to solve problems based upon the meanings that their socio-cultural structures provide (Ogunniyi 1988). This concept that all people incorporate new knowledge by connecting it to previous knowledge has been formalized and is now considered the foundation of constructivism. Students construct new knowledge and solve existing problems based upon existing knowledge. For young children, existing knowledge is primarily a result of their socio-cultural experiences. For teachers to communicate with students from all cultures, it is important that these teachers are aware of the breadth of cultural meanings that children own. Even with adequate conditions for teaching science, the socio-cultural characteristics that students bring into the classroom create differences in what teachers teach and the way the students interpret this knowledge (Jegede & Okebukola 1991).

Questioning strategies are a significant part of interactional tasks between teachers and students, but socio-cultural differences can influence instruction based upon questions (Heath 1988). Cross-cultural research has shown that uses of questions vary according to culture (Spindler 1988). Harkness (1977) found that in rural Africa, people in the community (not immediate family members) direct the highest number of questions to children. Goody's (1977) research of Native American culture showed that questions were not valued as an aid in learning. Blount (1977) observed a culture where "how" or "why" questions were seldom used around children. Cook-Gumperz (1973) found that most questions are to give commands or to explain punishment for not following commands.

The socialization of the child through the use of questions is exemplified in Heath's (1988) study of questioning patterns used by Southern (predominantly African American) parents from public housing and White middle-class classroom teachers. Heath's study compared types of questions African American urban parents asked their children and the types of questions White classroom teachers asked their own children at home to "train students to act as question-answerers, as experts on knowledge about the world, especially the names and attributes of items in their environment and those introduced to them through books" (Heath 1988, p. 110).

Heath showed that African American parents in this community asked questions of their children with far less frequency than did White classroom teachers. Futhermore, the questions asked African American children were rhetorical: responses were not expected. When asked questions which would elicit a response, these questions were primarily analogy (What's that like?) or story-starter (What happened to Maggie's dog?). One grandmother volunteered to Heath, "We don't talk to our children like you folks do [sic]; we don't ask em 'bout colors, names, 'n' things" (Heath 1988, p. 117). While children in this community had a rich linguistic environment, it did not prepare them for the type of questions they would encounter in the classroom.

Questioning strategies used by the classroom teacher have significant impact upon cognitive factors, such as the learning processes, and affective factors, such as self-esteem and motivation. It is important to determine if the types of questions asked of children reflect their sociocultural characteristics. This study was designed to determine the types of questions asked in a southern urban elementary science classroom. Due to the exploratory, naturalistic nature of this research, no null hypotheses were developed.

The population from which the sample was drawn consisted of students from an urban, primarily African American school in the southeastern United States. This neighborhood school is located in the middle of a public housing unit. Two second grade and two fifth grade classes were selected from the school for the study. Classes were chosen on the basis of the principal's recommendation and the agreement of the classroom teacher to participate in the study. The teachers were two males and two females. The ethnicity of these teachers were one African American and White in each grade. All of

the teachers were experienced, state-certified classroom teachers. Ninety-four percent of the students were African American. The other 6% were from Hispanic, Asian American, and White ethnic groups. Science test scores were not available, but the 1992 Iowa Basic Skills National Percentile rankings of reading and mathematics scores were published. The fifth grade students had reading scores at the 23rd percentile and mathematics scores at the 33rd percentile. The second grade students had reading scores at the 52nd percentile. These students were targeted for self-esteem programs to prevent dropouts.

The teachers were recorded (audio only), while teaching a science lesson. The teachers knew that they were involved in a research project, but did not know that their questioning was the target of this study. This procedure was repeated with each teacher two weeks later. Transcripts were made of the questions only. Two of the researchers independently evaluated the transcripts as to the types and numbers of questions asked.

Questions were judged based upon criteria developed by Padilla (1987). Categories were identified as cognitive memory, convergent thinking, divergent thinking, and evaluative thinking. Cognitive memory questions are directed toward rote memorization, recognition, and recall of facts. An example of this type of question would be, "What color is that rock?"

The focus of convergent questions is on a narrow objective (Orlich *et al.* 1990). Convergent questions require the students to generate their information that leads to the most acceptable answer (Ryan & Cooper 1984). Convergent questions require specific answers to specific objectives. An example of a divergent question might be, "Assuming roaches and rats survive a nuclear holocaust, how would life on earth evolve?"

Evaluative questions are basically divergent questions, but with an added component of a value judgement. Evaluative questions should have a set of criteria, preferably student-generated, by which the student assesses the appropriateness or value of an object or idea. An example of an evaluative question would be, "Given the tremendous amount of material the classroom teacher is expected to cover, should multicultural science education be part of the curriculum?"

Using the above criteria, the researchers evaluated each question as to whether it was cognitive memory, convergent thinking, divergent

thinking, or an example of evaluative thinking. Each researcher analyzed the questions separately. The interjudge reliability was 0.86.

The predominant type of questions used in these elementary school science classrooms was cognitive memory. Overall, cognitive memory questions were asked 68% of the time. Individually, the second grade teachers asked cognitive memory questions 64% of the time, with fifth grade teachers asking cognitive memory questions 72% of the time.

The next most frequently used strategy was convergent questions. Overall, classroom teachers asked convergent questions 21% of the time, second and fifth grade teachers using this type of questions 18% and 8% of the time, respectively.

The use of divergent questions ranked third in types of questions asked by classroom teachers. Divergent questions were used 20% of the overall time. Both second and fifth grade teachers used them 13% of the time.

Evaluative questions were seldom used in the classroom. Overall, classroom teachers utilized this method of questioning 6% of the time. Second grade teachers asked evaluative questions only 1% of the time. Fifth grade teachers asked them 7% of the time.

According to the information from Heath's study and the results of this research, urban African American children from public housing are rarely asked cognitive memory level questions at home. Yet, they enter a classroom that centers around cognitive memory questions. Some African American children are not as well prepared to answer these lower level memory questions as are the children of White classroom teachers (Heath 1988).

In this study, teachers (male, female, African American, and White) used cognitive memory questions as a primary teaching and evaluative tool in science. Assuming that this sample of students is representative of Southern urban African American students, here is a population of students who are being evaluated by their responses to cognitive memory questions. Thus, these African American students are not receiving equitable teaching and evaluations.

When working with students of different cultural backgrounds, it is important for classroom teachers to be aware of the socio-cultural characteristics of their students. In this study, teachers were communicating with and evaluating students in a style to which they have not

been acculturated to respond. This lack of communication could result in students who are knowledgeable being labelled as slow or unresponsive. These students could miss educational opportunities due solely to a lack of communication.

Recommendations

The United States is becoming increasingly multicultural; African American, Hispanic, and Native American populations of today are expected to comprise the majority of school-age children by 2005 (*Atlanta Constitution*). It is essential that classroom teachers develop the skills to communicate with all of their students. Teacher education programs need to incorporate this information in their curricula. Sending teachers into the classroom without knowledge of different socio-cultural characteristics and values will ensure failure of our future teachers and their students.

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14

Paths to Multiculturalism: One Perspective

J. Randy McGinnis

Multicultural teacher education is a journey of many paths that requires its individual travelers to come to grips with issues of racism, equity, discrimination, power, and cultural awareness arising out of specific social experiences. Through reflection after experience (Sergiovanni 1983), the knowledge, skills, and attitudes necessary for the attainment of a multicultural teaching perspective are developed. For those involved in teacher education, this development of a multicultural perspective in individuals is of vital interest due to the widely accepted goal to educate all teachers for effectively instructing students of diverse cultural and linguistic backgrounds (Atwater 1989). To accomplish this goal, teacher educators must have some idea of the real life instances that have influenced individual teachers of differing demographics and backgrounds to grapple with multicultural considerations. By attempting to understand teachers from their own point of view, a grounded theory (Glasser & Strauss 1967) of multicultural teacher education can be developed and used by multicultural teacher educators to identify significant translatable experiences and issues that can be used to guide other individuals on their private multicultural journey.

This chapter presents my personal reflections on life experiences which represent the issues of both majority and minority groups involved in my teaching career. Through these unique experiences, my reflections offer valuable insights on the paths along the journey of multicultural teacher education. My particular voice is that of a White American male who has taught both in Africa and in a large inner-city metropolitan school. This voice is expressed under the paths along my personal journey that I feel were meaningful to my growing multicultural awareness.

The eleven paths shared in this chapter are presented as honestly as possible so that those interested in multicultural teacher education can evaluate for themselves the merit of this individual's insights concerning his multicultural development.

Path One: Positive Experience with a Different Culture Before Teacher Education

From 1963 to 1966, as a child of six to nine, I lived in Europe as an American military dependent. Therefore, I experienced my first few years of school in another country. My experiences with the European culture were limited, since my life after the first few months of living on the economy (living off the military base among Europeans) was primarily centered on the military base; but I had many experiences over the three years that helped me develop an understanding of a culture existing outside of my own.

My parents had one set of older European friends whom I particularly remember visiting occasionally off base in their apartment. They spoke broken English with a strong accent. I looked forward to visiting them because their apartment was in a large European city, a place where I recognized people spoke a different language, ate different foods, and dressed differently from my family. They treated me with affection and made me feel that people who were different from my family could be family friends. Through their kindness, and by living in a foreign country, I came to accept as ordinary the concept of other cultures existing outside of my own.

Path Two: Positive Experiences with People of Different Colors and Ethnicity Before Teacher Education

As a public school military dependent student in schools in the American South after returning from Europe, I had everyday experiences with African Americans and students with mothers of other nationalities, including Asians, Europeans, and South Americans. I enjoyed good experiences with them at school and on my Little League and Babe Ruth baseball teams. I never thought about why those relationships ended outside of school or the structured extra-curricular activities in which I participated, but now I recognize that my family's life was centered around my relatives who shared the same cultural and ethnic background.

One instance that stands out during that period of my life was a voluntary after-school assembly in honor of the recently slain Martin

Luther King, Jr. I had studied his writing earlier in my tenth grade English class and had admired his commitment to civil rights and his talent in expressing himself in moral and poetic terms. As a result, I decided to attend the assembly. Once there, I was surprised to find I was the only White student present out of a school population of 2000, with over 1200 White students. I felt conspicuous, maybe for the first time due to my ethnicity at the school, but not unwelcome. The African American students present, almost all female, made me feel welcome and helped me with the lyrics of "We Shall Overcome" in a group singing. I realized that I knew very little about African American culture, which appeared rich. It made me feel better when I observed the few African American males present also being helped by the girls with the lyrics. Many of those females present at that assembly later would greet me in the school halls and talk with me in my classes for the rest of my high school days. Through these experiences, I began to feel comfortable in interacting with people of color in social situations in my own culture.

Path Three: Participation in a Teacher Education Program Taught by Instructors Representing The Dominant Student Ethnicity and Culture

At the age of 22, I left my home in a Southern state and flew to Swaziland, Africa, to begin my service as a mathematics and English teacher volunteer with the United States Peace Corps. (I had graduated six months earlier with a Bachelor of Science in geology, with a minor in philosophy.) My commitment was for a minimum of two-and-half years.

I looked forward to totally immersing myself in a different culture when I joined the Peace Corps. I anticipated that the language would be different and that clothing, housing, and some customs would be different from what I was familiar. I looked forward to an exotic culture. I had confidence that I would be able to learn the language with study, and with cross-cultural education, be able to fit in well with the foreign culture. My earlier positive experiences with a foreign culture and with people of color gave me confidence to succeed.

My instructors were all Swazis, and I felt comfortable with them.

Much of the twelve-week training program concentrated on siSwati language and cross-cultural lessons. My training group was composed of ten males and six females, all of us in our twenties. We were all White Americans, except for one African American male. I became close friends with him. It surprised me that for some of my training group, he was the first African American male with whom they had extensive contact.

Path Four: Appreciating Language as a Powerful Way to View Inside Another Culture

In studying the siSwati language, I found that the order of Swazi thought was different from that of the English speaker. One example of this difference is the way they would express the idea, "I want to eat food." They would say, "*Ngikufuna*." This translates as follows: *Ngi* - I, *ku* - food (*ku* short for *kudla* - food), *funa* - want (*funa* short for *kufuna* - to want). They therefore thought, in direct English translation, "I (bread) food want." This way of ordering their thoughts was alien for me as a native English speaker. To become reasonably fluent in their language, I had to move away from direct translation of English sentences quickly. My method was to have an idea to express, attempt to do so in their language by looking up words in dictionaries, try to say it with Swazis, ask for guidance in how to better say it in their language, and then try to memorize the way they indicated. It made me realize that to become truly bilingual, I needed to accept their syntax and their way of ordering the world. Through practice, their way of thinking began to seem very comfortable, although I always had my English filter with which to contend. As my abilities to speak their language increased, I occasionally caught glimpses of the beautiful order of their language and its completeness in describing a world view very different from the one from which I came. Those were epiphanic moments.

I memorized idiomatic phrases and used them in my daily speech until they became natural to me. In my classes, although the primary medium of communication was English, I used siSwati to provide "signposts" for my students to collect around cognitively when encountering new concepts. I believe my use of siSwati with the students' parents was particularly important. It put both the parents

and my students at ease, made me appear vulnerable and understandable to them, and illustrated the value I placed in their language and culture. It also allowed me to participate in community events and take on more of a role than simply expatriate academic teacher.

Path Five: Understanding the Role of the Unwritten Expectation of Behaviors in Different Groups' Cultures

In Swaziland, I quickly became aware of differences between my expectations of actions and the expressed actions of individuals in the different, majority culture. Perhaps my biggest realization was that the majority culture was so alien to my own that I could not with confidence easily anticipate actions or responses of individual people. For example, people often laughed when I thought they would be angry; other times, they grew offended when I thought they would be pleased. It was only when I could not predict the majority of people's everyday, ordinary reactions, that I realized how many actions in my own culture I anticipated and prepared to react to without consciously thinking. I became aware that actions of members of my own cultural group probably seemed as perplexing to those of other groups trying to anticipate our reactions from their perspectives. I came to have a deeper appreciation for the need of constant open communication to investigate conflicts with expectations of others behavior.

Path Six : Understanding How Physical Appearance Can Be Associated with Self-Esteem and "Being Part of the Group"

Although the Swazis had enough physical differences to be perceived as individuals, they had enough similarities to be viewed as members of the same group. It was surprising to observe that the physical differences of the African American male from my group placed him outside of the Swazi group, just as conclusively as the White Americans' physical appearance. To the Swazis, we were all non-Swazi.

My physical appearance was particularly shocking for many very young Swazis in my rural community. They reacted by crying loudly! It was both embarrassing and a very strong indication of how different

I looked from the majority group. I never wanted to be reminded how different I looked; I got tired of having to be aware of my physical difference and dealing with it. Within a year of my arrival, with my living situation more or less familiar to me, I usually was able to forget my conspicuousness among those who knew me in my community. Since I was the only White person within a 25 km radius, it had taken many months for me to be seen by most people in my rural community. Only visitors to the community responded to my outward differences, which came to be less common as time passed. I grew to forget how different I looked from the Swazis. Only when my students stared at the straight hair on my head or pointed at the hair on my feet and legs when I wore traditional Swazi dress was I reminded of my physical difference from them. That was uncommon. A visitor sent me a photograph taken of me while I was teaching there. When I looked at it, I was shocked at how strange I looked among my students. I looked very different from any other person I knew on a daily basis. I admired the way the Swazis looked. I wished my hair could be as neat, my skin as dark. To me my color made me look weak; my nose looked too long and narrow. I became aware of how individual self-image could be influenced by the majority culture's appearance.

Path Seven: Associating the Confidence to Take Risks with Quality and Type of Education

Throughout my time in Swaziland, I felt confident in my abilities to do my job. The selection process and training of the Peace Corps had assured me that I was considered to have the skills and abilities necessary to be a successful community development worker. An instance that illustrates my confidence took place during my first week at site. A primary school teacher sent a child to request that I see if I could repair her propane refrigerator. I agreed to try. My headmaster who was present asked if I had training in refrigerator repair. I said, "No, but I'd give it a try." He was incredulous that I would attempt to fix something I had no explicit training to do. In spite of his hesitation, I went and took a look at the refrigerator, which had been broken for six months. I had never seen a refrigerator like it; but I believed that since it was mechanical, the broken part could be found and a possible

repair attempted. Within minutes, I found that the wick was stuck in the cogs. I removed the wick, rewound it, and lit it. The refrigerator was fixed. No one else had agreed to look at it because they had no formal training in refrigerator repair. Without this formal training, there was no confidence to attempt the repair. My confidence came from my education level and from my belief in my abilities to face new situations and to succeed. The one non-White American male I had to compare with, my African American friend, felt the same as I in this regard. In fact, he encouraged several of the White volunteers to join him in writing a textbook on teaching mathematics. He had no formal training in writing textbooks, but he was willing to try and to coordinate the rest of our efforts. I therefore came to think that confidence was not tied to any ethnicity, but primarily to quality and type of education.

Path Eight: Experiencing a Minority Status in My Own Culture

Six months after returning to the United States upon completing my Peace Corps service in a rural site in Swaziland, I accepted a position in an inner-city high school in a large metropolitan center on the east coast.

My school had a fluctuating student population of approximately 5,000. It was labeled a minority-majority school because the student body consisted of approximately 50% Puerto Rican and 50% African American students. There were also one or two White students. The physical science faculty consisted primarily of five White males who were Jewish. There were also two African American males, one African American female, one White Jewish female, and two non-Jewish White males. Overall, the school faculty of around 250 was approximately 85% White and 15% people of color.

My students were a mixture of nationalities and ethnicities. There were many students from Puerto Rico and the Caribbean. Others were African American with various ties with the South. None shared my background. The result of these demographics was that I became a member of a minority group in the context of the school, although in society in general I was a member of the dominant cultural group.

Path Nine: Awareness of the Impact of Teacher Expectations on the Behavior and Achievement of Students From Different Cultural and Ethnic Backgrounds

To some of the teachers at the inner-city school in which I taught, the students were viewed as nonhuman. They were labeled as "animals," "gorillas," and considered totally uninterested in education. Many conversations in the teachers' lounge centered around how the school had "changed" over the years from an academic environment to one whose goal was to keep the "natives" calm. Those few White teachers who had attended the high school themselves as students particularly lamented over the change in the school atmosphere. I too found it very unlike what I had come to see as a school, both in the South and in Swaziland. The foul language, chaotic nature of the halls, and blatant acting out by some students was unlike anything I had ever experienced. I did not blanketly condemn the students, however, as many other teachers did. I evaluated that the situation consisted of a very few acting-out, troubled youngsters ruining it for the many. I saw myself as having to project the role of a teacher who set the tone of learning in my classroom.

Once, shortly after beginning to teach there, I experienced difficulty with two football players in my science class. After discussing the matter with my department chairperson, I went to see their football coach after school when they were practicing. I introduced myself to the coach, a short White male, and explained my problem. He looked me over from top to bottom and said it was understandable that I had trouble with the students because: *(a)* I was White, *(b)* I was young, and *(c)* (which he nearly spat out) I was skinny. I looked him squarely in the eyes and agreed, but then told him I also was "a damn good teacher" and needed his help with these two students for their own good. That appeared to mean something to him since he immediately called the two students over to us, whom I had noticed were watching from a distance, and told them that from then on I was to be considered a coach on the team. That meant, he slowly stated, that the new "coach" had the right to have them sit out football games if they "screwed around" in class. I used that threat a few times to control their behavior in class during the rest of that quarter. They both came to like the class and would drop by to visit for a few minutes

semesters after they had successfully passed the class. That was an instance where I felt that I could learn to be a successful teacher with my students by first appealing to what they found valuable. Given a chance, I could then "sell" my subject by making it relevant and interesting to their lives.

In contrast to my African students, I found a commonality with my city students that extended beyond an interest in an academic subject and being members of the same species. For instance, we shared interests in sports, entertainment, and our nation's actions as indicated in the newspapers. My teaching vocabulary was much greater than that I used overseas due to this commonality upon which I could draw. I felt a closeness to my students because we were all Americans. I knew paths of success they could take with which I could help them. As a result, although I recognized that the African American youth culture and the Puerto Rican culture were different from my world view, I believed that we shared much that was the same: I felt curious about their cultures and expressed that to my students.

Since I had achieved success as a teacher with students of a totally different culture, I had confidence that if I did my work to the best of my abilities, I could provide experiences so that my American inner-city students could also succeed.

Path Ten: Awareness of the Importance of Majority Representation Among the Teacher Faculty

One particular instance that troubled me in relating to being a White male teaching students who were non-White concerned a student's perspective of teaching abilities. One day, while in conversation with one of my students about scheduling for another subject, he told me he had been unhappy with being assigned to a particular teacher. When I asked why, he told me that teacher was Black and everyone knew the White teachers were better, knew more, and cared more. He said that only the few Blacks who could not do anything else better taught school. This disheartened me because my student was an African American, and I knew that the few African American teachers at the school were in no way inferior to the White teachers. In other instances when I asked my students if they were considering teaching

careers, they told me they didn't think it was an African American or Puerto Rican profession. Either it was too low-paying (although when I informed them of the entry salary, they were surprised how much it really was) or they didn't see themselves putting up with kids who were hard to handle. Besides, as they countered, "You didn't see many of them there now did you?" Therefore, it wasn't for them.

This dilemma of being a White male who could not be a role model of a member of their particular ethnicity, gender, or color, but who wanted to be a good teacher and good adult role model to them was never resolved. I came to be militant in espousing the need to have the faculty better represent the student body. I thought it was the minimal role of the federal government to sponsor minority students to become teachers and then serve in schools such as mine for some period of time. I felt that the students needed to be taught by a more representative faculty than what was present to ensure that we did not unwittingly project that the students of color were unable to become teachers and administrators of public schools. Only the security and cafeteria staff were predominately composed of people of color. My fellow teachers thought that with the current economic reality, a person of color with a science background necessary for a science teaching certification would be convinced by the higher salaries to enter private industry instead of teaching and that change in composition of the faculty would not come about for a long, long time—if ever. I agreed with them, as long as encouraging initiatives for people of color to enter teaching were not perceived as important.

Path Eleven: Awareness of Teachers' Cultural Background Affecting the Expectation of Student Behavior and Achievement

I thought much about a friend of mine, an African male from Senegal, Africa, who had much more trouble than I did teaching at our inner-city school. He felt that without the students' family structure to back him up in the classroom, and without the right to administer corporal punishment, that he was powerless. He could not be the teacher he had been in Africa. Within a year, the administration terminated his employment due to his management problems. He left very embittered, blaming his students for the situation.

I saw him as unable to reshape his concept of what was an effective teacher. He needed the students to be a certain way—quiet in their seats, pens on their notebooks, and ready to take notes. That would enable him to be a lecturer and to feel successful. He never saw himself as I did in the role of the teacher. I kept in mind my goal of what I wanted my students to be at the end of the term. I was eager to explore with my students different learning styles and develop different teaching strategies to meet those needs. As a result, I survived and prospered as a teacher in that public high school inner-city multicultural environment. My inflexible teaching friend perished.

Implications for Multicultural Teacher Education

Multicultural education theorists, such as Banks (1987) and Baptiste (1988), have advocated hierarchical models of multicultural teacher education. Their models indicate that the individual teacher potentially passes through seven "stages of ethnicity" (Banks 1987), or that the teacher education institution itself can be conceptualized as potentially passing through three "levels of multiculturalism" (Baptiste 1988). In both models, minimum multicultural competencies are identified that will enable the teacher to be multiculturally skillful with students.

A fundamental tenet of the developmental models of multicultural teacher education is that teachers gain multicultural competencies after passing through lower steps on the hierarchy of competencies. For Banks, the acceptable stage of teacher education is Biethnicity, which is characterized by the teacher having the necessary attitudes, skills, and commitments to participate within their own ethnic group and another ethnic culture. For Baptiste, it is Level Two, where the institution exhibits interrelated courses, diverse faculty and/or student body, and comprehensive programs. Both theorists postulate higher levels of multicultural competencies in their models, but do not realistically believe that all teachers or teacher education institutions will be able to reach them, or necessarily need to reach them, in the abbreviated time of a formal teacher education program.

The paths selected by this White American male teacher offer insight on how particular individuals with their own idiosyncratic,

yet representative age-specific, gender-specific, cultural, and ethnic backgrounds are encouraged along their developmental journey of multiculturalism by specific events and social situations throughout their lives. This particular voice notably presents the following issues relevant to the attainment of multiculturalism in any teacher education program: the development of language proficiency; the effect of physical appearance as a potential barrier to communication between diverse groups; the development of self-esteem; preparation of teachers to interact with people of a different culture; teacher expectations relating to behavior and possible achievement of students from diverse backgrounds; the process of gaining acceptance and power in a multicultural teaching context; student expectations of teachers of color, role models and significant others; and general teacher-student interactions in multicultural situations. The following table lists the paths identified by this individual.

As a practitioner's reflective knowledge base grows through contributions of individuals who have begun the journey of multiculturalism, themes and patterns translatable to good multiculturalism teacher education will emerge. This is one White American male's contribution to that constellation of voices.

A White Male's Paths Leading to Multicultural Teacher Awareness

Path One:	Positive Experience with a Different Culture Prior to Beginning Teacher Education
Path Two:	Positive Experiences with People of Different Colors and Ethnicity Before Teacher Education
Path Three:	Participation in a Teacher Education Program Taught by Instructors Representing the Dominant Student Ethnicity and Culture
Path Four:	Appreciating Language as a Powerful Way to View Inside Another Culture
Path Five:	Understanding the Role of the Unwritten Expectation of Behaviors in Different Groups' Cultures

Path Six:	Understanding How Physical Appearance Can Be Associated with Self-Esteem and "Being Part of the Group"
Path Seven:	Associating the Confidence to Take Risks with Quality and Type of Education
Path Eight:	Experiencing a Minority Status in My Own Culture
Path Nine:	Awareness of the Impact of Teacher Expectations on the Behavior and Achievement of Students from Different Cultural and Ethnic Backgrounds
Path Ten:	Awareness of the Importance of Majority Representation Among the Teacher Faculty
Path Eleven:	Awareness of Teachers' Cultural Background Affecting the Expectation of Student Behavior and Achievement

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Notes on the Contributors

James A. Anderson is dean for the Division of Undergraduate Studies at North Carolina State University. He is a former professor of psychology at Indiana University of Pennsylvania. Dean Anderson is an advocate for diversified curriculums which meet the needs of diverse student populations. Some of his most recent keynote addresses include: "Diversity: Connecting the Pieces on Campus," For Diversity Conference, Texas A & M University; and "Frontloading the Survival Equation for Diverse Populations," National Conference on Academic Skills Centers, University of Cincinnati. Two of his most recent publications are "Diversity and Leadership on the College Campus," in the *Conference Proceedings of the Leadership Education Conference,* and "Acknowledging the Learning Styles of Diverse Populations: Implications for the College Classroom," in *New Directions for Teaching and Learning* (Nancy Chism *et al.*).

Carol M. Archer is on the faculty at the Center for Executive Development in the College of Business at the University of Houston. For the past thirteen years, she has developed and taught classes in cross cultural communication at the Language and Culture Center at the University of Houston. During her tenure, she has taught students from the Middle East, Asia, and Latin America, as well as the U.S.A. She served as the cross cultural consultant for the PBS series, "Images of America" and designed and wrote cross cultural training programs and videos for Memorial Hospital Systems and the Immigration and Naturalization Services. The developer of the "Culture Bump" methodology for resolving cultural conflicts, she is the author of the article, "Culture Bump and Beyond" published in *Culture Bound: An Anthology* by Cambridge University Press. In addition she has written *Living with Strangers in the USA* published by Prentice Hall in 1990, is contributing author to *Learning Across Cultures,* to be published by NAFSA in 1993. She has also designed and implemented cross cultural training programs, communication workshops, and overseas orientation programs for various organizations and international corporations including AT&T, Aramco, Pecten, Princeton University, Houston Metro, and the World Trade Association.

Mary M. Atwater is an associate professor in the Department of Science Education at The University of Georgia. She was awarded the 1990 NSTA OHAUS Award for Innovations in Four-Year College Teaching for her paper describing a preservice multicultural science teacher education program. She has written extensively in the area of multicultural science education in such journals as *The Journal of Research in Science Teaching, The Journal of Elementary Science Education, Journal of Science Teacher Education,* and *The Science Teacher.* She is the author of the chapter "Research on Cultural Diversity in the Classroom," which will appear in the *Handbook of Research on Teaching and Learning,* edited by Dorothy Gabel. She provided the leadership for the establishment of the Division of Multicultural Science Education in the National Science Teachers Association and was the first president of the Association for Multicultural Science Education.

H. Prentice Baptiste, Jr. is a professor and chair of Educational Leadership and Cultural Studies at the University of Houston. He served as co-editor of the *Journal of Educational Equity and Leadership* and publishes regularly in the field of multicultural education. He co-edited and wrote a chapter for *Leadership, Equity, and School Effectiveness.* His articles on multicultural education have appeared in such journals as *Journal of Educational Issues of Language Minority Students, Journal of Educational Equity and Leadership,* and *Science and Children.* He has worked extensively with inservice teachers in urban settings and made numerous presentations at conventions.

James Boyer is professor of curriculum and instruction and former director of the Institute on Cultural Understandings at Kansas State University. His research focuses on the provision of equitable human services to all populations, but especially to those populations considered ethnically, culturally, and linguistically different from the majority. His books include *Curriculum Materials for Ethnic Diversity, Multicultural Education: Product or Process? Teaching the Economically Poor, Curriculum and Instruction After Desegregation,* and *Racial Integration and Learners from Limited Income Families.* He has served as educational consultant, lecturer, administrator, and teacher in four states. His services have been in demand for schools, corporate training agencies, colleges and

universities, community groups, and governmental agencies. He has been active with teacher education projects and was the first recipient of the Presidential Award for Distinguished Services to Minority Education.

Gina Russler Dyer provides contractual and consultative services to Hall County Schools. She received an Education Specialist degree from the Department of Education Psychology at the University of Georgia. She is interested in the development of multicultural curriculum in public schools and the assessment of different ethnic groups of students.

Marilyn Frankenstein is an associate professor and the chair of the Center for Applied Language and Mathematics in the College of Public and Community Service at the University of Massachusetts in Boston. She is the author of *Relearning Mathematics: A Different Third R - Radical Maths (Vol. 1)*. She is co-editor of Criticalmathematics Educators Group Newsletter and has written extensively and made presentations in the area of criticalmathematics, thus bringing a critical perspective to this book.

Catherine M. Gardner is assistant professor of education at Mercer University and earned her doctorate in science education at The University of Georgia in 1992. Prior to that time, she served as a classroom science teacher in North Carolina, South Carolina, and Georgia public and private school systems and taught at Tift College in Forsyth and Gordon Junior College. Her research interests address the affective domain and environmental ethics with the ultimate goal of making science accessible to our culturally diverse society.

Evelyn Hart is a kindergarten teacher at Atkinson Elementary School in Griffin, Georgia. She has been a classroom teacher for seven years and recently completed her educational specialist degree at Mercer University.

Bobby Jones (deceased) was most recently the Newton Professor of Education at Mercer University. His extraordinary career in education spanned 23 years. He taught elementary school mathematics in

Austell, Georgia and secondary math in Atlanta and Macon. He later served as curriculum director for Bibb County Public Schools. He left that position in 1969 to join the Students Affairs Division at Mercer University. His appointment in 1972 as associate professor of education made him the first full-time African American professor at Mercer University. Throughout his career, he was very involved in helping African American youth in urban areas of Macon and Atlanta. Among his more famous students are current NBA stars Kenny Anderson and Alonzo Mourning. His commitment to teaching, contributions as a role model for students, and service to the University earned him the prestigious Spencer B. King Award for faculty excellence. He is missed by all who had the fortune and honor to work with him.

Jane Butler Kahle is Conduit Professor of Science Education at Miami University in Oxford, Ohio. She is a member of the National Academy of Science Committee on High School Biology Curriculum and the Association of American Colleges' Advisory Committee on Undergraduate Curriculum. Currently, she is working to develop a theoretical model for gender research in science education. She has directed twenty major funded projects which explored and analyzed ways to improve science education, particularly for women and students from underrepresented groups in the sciences. Her publication record includes 120 articles and 12 books and monographs. She authored *Teaching Science In the Secondary Schools* and *Double Dilemma: Women and Minorities in Science Education.*

James **Randy McGinnis** is a recent doctoral graduate from the Department of Science Education, a former assistant professor at The University of Georgia and currently is an assistant professor in the Department of Curriculum and Instruction at the University of Maryland at College Park. His primary research interests focus upon the impact of socio-cultural factors on the teaching and learning of science and teacher decision-making in exemplary science classrooms with cultural diversity. These interests are reflected in his dissertation, *Science Teacher Decision-Making in Classrooms With Culture Diversity.* He taught mathematics and science in Swaziland for three years where his students earned the highest academic rating on the tenth grade national exams.

Julio C. Mosquera Padron is a doctoral student in mathematics education at The University of Georgia. He is currently working in research and curriculum development at the National Center for the Improvement of Science Education, and he is an assistant professor of mathematics at the Simon Bolivar University in Venezuela. He has published articles in *The Mathematics Educator* and other journals.

Kelly Radzik-Marsh received her master's in science education with a specialization in science writing from the University of Georgia. She is the editor of the Georgia Department of Education Science Resource Guides Grades 4-8. She was also involved in the writing, editing, and production of the Physical Science Resource Guide, Grade 9. Currently, she is working as a freelance science writer and editor.

Sheryl L. Santos is an associate professor in the College of Education at Arizona State University. She was awarded a Fulbright-Hays Abroad Fellowship to Egypt and Jordan. She has published in the area of bilingual education in such journals as *Action in Teacher Education, Journal of the National Association for Bilingual Education,* and *Teaching Exceptional Children.* She authored chapters in several books and has been awarded eight grants in bilingual education. In addition, she speaks three languages other than English: Spanish, French, and Arabic.

Walter G. Secada is associate dean in the School of Education and associate professor of curriculum and instruction at the University of Wisconsin-Madison. He is also associate director of the National Center for Research in Mathematical Sciences Education. Dr. Secada's research interests focus upon equity in education, bilingual education, and school reform. He has published numerous articles related to these areas. His articles appear in *Child Development, Journal of Research in Mathematics Education,* and the *Peabody Journal of Education.* Dr. Secada has also been published in many books and has presented at over 21 conferences. Two of his most recent publications are the introduction to *Needed: An Agenda for Equity in Mathematics Education* (special issue of the Peabody Journal of Education), which he edited with Meg Myer, and "Race, Ethnicity, Social Class, Language, and Achievement in Mathematics" in the *Handbook of Research on Mathematics Teaching and Learning* (edited by D. Grouws).

G. Pritchy Smith is a professor in the Division of Curriculum and Instruction at the University of North Florida in Jacksonville, Florida. He was a guest editor of the *Urban Educator* and is one of the foremost authorities on the impact of testing on teachers of color. In addition, he is a founding member of the National Association of Multicultural Education. Dr. Smith has been a professor at both historically Black and predominantly White institutions. He is an author of a chapter in the book, *African-American Education: Issues of History, Gender, and Politics*, edited by Castenell and Pinor.

Marilyn E. Strutchens is a recent doctoral graduate from the Mathematics Education department at the University of Georgia and is currently an assistant professor in the Department of Curriculum and Instruction at the University of Kentucky. Her research and writing focus on the areas of multicultural education, especially on the mathematics achievement of African American students. She is the co-author of a compilation, *Bibliography of Multicultural Issues in Mathematics Education* (with Julio Mosquera Padron and Patricia Wilson). She is currently helping to develop resource materials for culture-inclusive mathematics for grades 6-12. She is a member of the Multicultural and Gender Task Force of the National Council of Teachers of Mathematics.

Woo-Hyung Whang recently received his doctorate in mathematics education from The University of Georgia. His research interests are cross-cultural issues in mathematics education with an emphasis on word problem-solving. He has also helped to develop resource materials for culture-inclusive mathematics for grades 6-12. He has a full-time faculty position at Chun-chon National Teachers College in Chun-chon, Korea

Patricia S. Wilson is an associate professor in mathematics education at The University of Georgia. She is active in both preservice and inservice teacher education, as well as curriculum development in mathematics for grades K-12. For the last three years, she has organized graduate seminars related to research, teacher preparation, curriculum, and classroom practices. She has designed and taught a

mathematics history course from a multicultural perspective. Currently, she is planning a series of workshops that will bring mathematics teachers together to plan ways of incorporating culture-inclusive mathematics into their curricula. Dr. Wilson's research is related to children's mathematical reasoning. She has just edited a research interpretation book, *Research Ideas for the Classroom: High School Mathematics*.

MULTICULTURAL EDUCATION: INCLUSION OF ALL

Published by The University of Georgia
College of Education

Designed by Virginia Calder
Center for Educational Technology
with type set in ITC Legacy Sans
font designed by Ron Arnholm
UGA Department of Visual Arts

Printed by Thomson-Shore, Inc.
in Dexter, Michigan
on 60 lb. Glatfelter Thor Recycled

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